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Free gold as a constraint on monetary policy during the early stages of the Great Depression

Josephine Matilda McElhone
Iowa State University

FREE GOLD AS A CONSTRAINT ON MONETARY POLICY DURING THE EARLY STAGES OF THE GREAT DEPRESSION

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Josephine Matilda McElhone

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Head of Major Department

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Dean of Graduate College

Iowa State University
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CHAPTER I. INTRODUCTION

Economic Crisis and Reserve System Response, 1929-1932

The autumn of 1929 brought the collapse of the New York stock market and the beginning of the decade during which Federal Reserve policy was subjected to its most critical test. The contemporary consensus is that the System failed this test miserably. It is contended that Federal Reserve policy during various phases of the depression was characterized by inaction, by unjustifiably slow and insufficient action, or by action in the wrong direction in the face of rapidly deteriorating conditions. In this thesis, attention will be focused on monetary policy during one of the most critical periods of the depression decade, and in particular on the analysis of that policy presented by two of the System's most influential critics, Professors Milton Friedman and Anna Schwartz (18). The interval to be considered is the period between Britain's abandonment of the gold standard on September 21, 1931, and the passage of the Glass-Steagall Act on February 27, 1932.

System officials regarded their policy during the first two years following the "great crash" as one of easy money. The discount rate, the traditional tool of monetary control, had been reduced from 6 percent at the New York Bank in October, 1929, to 2 1/2 percent by late June, 1930. In May it stood at 1 1/2 percent, an unprecedentedly low level. Open market operations, whose usefulness as a policy weapon was a more recent discovery, were also utilized. During the last quarter of 1929, Reserve Bank holdings of government securities rose from $160 million to $510 million. An additional $220 million was purchased during 1930. Buying

rates on acceptances at the Reserve Banks were subjected to successive reductions from the fall, 1929 level of 5 1/8 percent until they reached an all-time low of 1 percent in May, 1931.[1] In spite of these policies, and an inflow of gold amounting to $700 million during 1930 and the first half of 1931, member bank reserves and the money stock declined. Liquidity crises, characterized by bank suspensions and conversion of deposits into currency, occurred during the last quarter of 1930, and, with much greater severity, in the spring of 1931. Hopes for a revival in early 1931 were cut short by this second banking crisis, and economic indicators accelerated their downward trend.

The summer of 1931 saw the collapse of the credit structure in Central Europe which culminated in the British departure from gold in September. Austria's largest bank, the Credit Anstalt, failed in May, and during June and July the crisis spread to Germany. On July 13, the entire German banking system was closed by decree. The Standstill Agreements of August, 1931, under which foreign short-term creditors agreed not to withdraw balances for six months, did not prove to be a remedy. German banks reopened, but Britain, who with the U. S. was the principal short-term creditor of Germany, was in a precarious position. Her short-term assets were immobilized and a large volume of foreign funds were held on deposit in London which could be demanded at any time. The extension of credits to Britain by the Federal Reserve System was of little help, for the trickle of withdrawals from London developed into a torrent, and on September 21, that bulwark of Europe suspended the gold standard. The Scandinavian countries and a number of others followed suit in 1931 and

[1] The System was not given the power to alter reserve requirements until 1935.

1932, and in nations where the gold standard was maintained, the adoption of rigid controls on foreign exchange transactions was common.

The United States was not to escape the effects of this crisis. Fear that the world-wide demise of the gold standard was underway led to gold withdrawals from the U. S., beginning immediately after the British suspension. In the six weeks following the announcement from London, the U. S. lost $725 million in gold -- up to that time, the largest movement for a similar period ever experienced by any nation. By June, 1932, the total gold outflow had risen to $1.1 billion. These difficulties were soon compounded by others. The public, frightened by the external drain, intensified the internal drain. During September and October, half a billion dollars in currency was withdrawn from banks; by the end of the year, $200 million more had been converted from deposits to currency. Bank suspensions rose at an alarming rate.

Monetary authorities have drawn much fire for their policy during these catastrophic months. Their initial response to the gold drain was the traditional one -- discount rates were increased, the rate at the New York Bank going to 3 1/2 percent on October 16. There was little question about this policy -- it was the response expected of sound central banks faced with an external drain, even when this problem was accompanied by an internal crisis. The advice of Bagehot (7) on this point had been carefully adhered to for generations:

> " ... periods of internal panic and external demand commonly occur together. The foreign drain empties the Bank till, and that emptiness and the resulting rise in the rate of discount tend to frighten the market." (7, p. 56)

To treat "this compound disease," the Bank "must raise the rate of interest as high as may be necessary" to stop the foreign drain of gold, and "at the rate of interest so raised it must lend freely." (7, p. 56) British, as well as American, policy in 1931 had followed this dictum, the Bank rate rising from 2 1/2 to 4 1/2 percent during July, the first month of gold withdrawals.

In addition to making discounting more costly, the Reserve Banks raised their buying rate on acceptances by successive steps until it reached a high of 3 1/8 percent in November. The System also purchased government securities, but the size of the open market operations during the latter part of 1931 was very puny in light of the critical banking situation -- only $90 million were bought between August and the end of the year.

System officials and their defenders have contended that sizeable open market purchases were impossible during the period from the British suspension until February, 1932, when the Glass-Steagall Act was passed. The restraining factor was, they claimed, the free gold position of the Federal Reserve Banks. Free gold was defined as total reserves of the Reserve Banks less all legal reserve and collateral requirements against Federal Reserve notes and deposit liabilities. These requirements included a 40 percent reserve against Federal Reserve notes in circulation, a 35 percent reserve against deposits, and 100 percent collateral in the form of gold or eligible paper against Reserve notes issued to Reserve Banks. Any gold held as collateral could also be counted as part of the 40 percent reserve, however. Therefore, with sufficient holdings

of eligible paper, 60 percent of Federal Reserve notes could be collateraled with this paper and the collateral requirement would add nothing to gold requirements.[1] When eligible paper was not available to this extent, however, it was necessary to substitute gold as collateral, and free gold dropped correspondingly.

Collateral requirements became important in the fall of 1931. The level of free gold had declined from approximately $1 billion at the time of the stock market crash to $600 million in the fall of 1931, due mainly to the rise in currency hoarding and to a dramatic reduction in member bank borrowing. Hence, there were more notes to be covered and less eligible paper available with which to cover them. The proportion of notes collateraled by gold rose, and free gold was depleted. The crisis in late 1931 put new strains on free gold from external and internal sources. The gold drain diminished the reserves of Reserve Banks, and the excessive demand for currency increased Federal Reserve notes in circulation. In spite of rapid rise in discounting as banks struggled for liquidity that season, free gold dropped to $416 million on February 24, 1932.

The System maintained that had large open market purchases been undertaken in the fall and winter of 1931, member banks would have used the proceeds to repay indebtedness, and perhaps would have sold fewer acceptances to Reserve Banks. The resulting decline in eligible paper would have necessitated the holding of more gold collateral, and might have

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[1]This is only approximately correct. See Chapter 2.

resulted in the complete elimination of free gold. Furthermore, the last of the French short-term balances were not withdrawn until June, 1932, but in forming policy during late 1931, Reserve officials had to take into account the possibility that they might be taken home as gold at any time. This would have subjected free gold to an even greater strain.

The passage of the Glass-Steagall Act on February 27, 1932, according to monetary officials, made possible the easy money policy which had previously been infeasible. Under the provisions of this law, the Federal Reserve Board was authorized, until March, 1933, to permit the use of government securities as collateral for Federal Reserve notes. Therefore, even if purchases of governments by the Reserve Banks were followed by an equivalent reduction in discounting, the volume of paper available for use as collateral would now be undisturbed. Consequently, the free gold position would not deteriorate due to open market purchases unless currency in circulation or some other determinant of free gold were adversely affected.

Within the week after the Glass-Steagall bill became law, the System embarked on a large program of open market purchases, initially at the rate of $25 million a week, and later at the vastly increased rate of $100 million per week. The campaign ended in August, by which time Reserve Bank holdings of government securities had risen by over $1 billion. The target of monetary policy had by this time become the maintenance of excess reserves at a level of $250 to $300 million, and due to an influx of currency and expansion of the gold stock during the second half of 1932, this level was maintained without any further purchases. Hence, the program came to a close.

It is clear that prior to September, 1931, it was technically possible for the monetary authorities to have pursued a more vigorous course. Free gold was close to $1 billion throughout most of this period, and gold stocks were rising. It is highly unlikely that even open market purchases at the 1932 rate would have made the free gold position untenable. With the advantage of hindsight, it is also obvious that a more vigorous policy was sorely needed. In spite of the actions taken to ease conditions, the money stock, prices and incomes continued their descent, and the unemployment rate soared upward.

In defense of the molders of monetary policy, however, it must be conceded that by the standards of their day, they had been far from passive. Discount and bill buying rates were slashed to the lowest levels which had ever been known to that time. Although the rate of purchase of government securities is dwarfed by a comparison with the operations of today, it was enormous for that time. "There has never been an operation as big ... in this country, or in any country," asserted the Governor of the New York Reserve Bank (47, p. 500).

The Severity of the Free Gold Problem: The Views of Friedman and Schwartz

Professors Friedman and Schwartz (18) contend that even during the critical period after the British abandoned the gold standard, free gold imposed no real constraint on Federal Reserve policy. "Despite the attention it has since received," state these authors, "we do not believe a shortage of free gold exerted any major influence on Federal Reserve policy for five reasons." (18, p. 401)

"(1) The earliest published full-dress discussion of free gold during the 1929-33 contraction we have found is an article by Benjamin Anderson in the Chase Economic Bulletin of September 29, 1930." (18, p. 401)

The article warned of a potential shortage of free gold, but there is no evidence that it exerted any influence on System officials, explain Friedman and Schwartz.

"(2) The earliest unpublished System document on free gold is a memorandum by Goldenweiser, written on January 3, 1930 ... The memorandum makes clear that the Reserve System regularly kept track of free gold, and that its level was not at the time a source of concern to the Board." (18, p. 401)

Other memoranda reinforce the impression that the System did not regard free gold as a serious limitation on its alternatives, even during September and October, 1931. "Hence the actual amount of free gold throughout the whole period was sufficient to have permitted extensive open market operations." (18, p. 402)

"(3) While free gold was alluded to from time to time at meetings of the [Open Market Policy] Conference or of its executive committee or of the Federal Reserve Board or of the New York Bank directors, it was almost always mentioned as a problem by persons who had opposed open market operations all along on other grounds; it was never given as the principal argument against purchases, and the objections raised on this score almost always were immediately countered by figures showing that a shortage of free gold offered no serious limitation to policy. It is impossible to read in full the record of proceedings of the Open Market Policy Conference and of meetings of the New York Bank directors during the period from September 1931 through February 1932 and assign great significance to free gold as a factor determining policy." (18, pp. 402-03)

"(4) If free gold had been a serious handicap to a desired policy, feasible measures fully consistent with past policies of the System were available, even during the height of the gold drain, to relieve the free gold problem." (18, p. 404)

These included certain bookkeeping adjustments, namely the reduction of Federal Reserve notes in the tills of the issuing Reserve Banks against which collateral was required; the purchase of bills, which were eligible as collateral, rather than government securities; and the encouragement of member bank borrowing.

> "(5) Finally, the enactment of the Glass-Steagall Act ... entirely removed the problem of free gold. Yet ... its enactment did not lead to a change in Federal Reserve policy. The large scale open market operation of 1932 was begun six weeks later primarily because of Congressional pressure and was allowed to lapse not long after Congress adjourned." (18, p. 406)

> "The conclusion seems inescapable that a shortage of free gold did not in fact seriously limit the alternatives open to the System. The amount was at all times ample to support large open market purchases. A shortage was an additional reason, at most, for measures adopted primarily on other grounds. The removal of the problem did not of itself lead to a change of policy. The problem of free gold was largely an ex post justification for policies followed, not an ex ante reason for them." (18, p. 406)

Friedman and Schwartz go even farther and suggest the specific alternative which the monetary authorities should have pursued between August, 1931 and January, 1932 -- a purchase of $1 billion in government securities. A series of assumptions as to the repercussions of this policy on discounts, bills bought, and deposit ratios allow them to conclude that "an open market purchase of that size would have been adequate" (18, p. 399) to prevent the 12 percent decline in the money stock which occurred during that interval.

Objectives of This Study

The purpose of this thesis will be to investigate the quantitative aspects of the free gold problem which arise from the Friedman-Schwartz analysis. We will attempt to answer three questions:

(1) Was the amount of free gold ample, as Friedman and Schwartz assert, to support a $1 billion purchase of government securities?

(2) To what extent was it possible for the System to exploit the alternatives described under Point 4 above? How much relief to the free

gold position could have been obtained from the reduction of counter cash in the Reserve Banks, purchases of acceptances, and from the encouragement of discounting?

(3) Would an open market operation of the size suggested by Friedman and Schwartz have been sufficient to maintain the money stock at a constant level?

We will discuss in a concluding chapter, but only in a rather cursory manner, the reasons given by Friedman and Schwartz in Points 1, 2, 3 and 5 for their belief that free gold was no insurmountable barrier to policy. An evaluation of these points will necessarily be on a more subjective level, since they involve the state of the Federal Reserve mind. However, it is not our primary purpose here to determine the extent of Federal Reserve anxiety over the free gold position, but rather to investigate the degree to which such anxiety would have been justified for monetary authorities who were extremely desirous of pursuing a large open market purchase program in late 1931.

The Severity of the Free Gold Problem: Opinions of Other Authorities

The general consensus among those who have written on the free gold problem, and particularly among those who wrote during the depression, has been that collateral requirements did indeed impose a serious constraint to the initiation of an easy money policy in the fall of 1931. One fundamental basis for agreement among most of these authors was what we will term the need theory of borrowing, first coherently expounded by Winfield Riefler (37) and later by Burgess (12). According to this view, member

bank borrowing is inelastic with respect to the discount rate. Banks will not borrow simply to lend at a higher rate. The tradition against borrowing has been too strongly reinforced in the banking mind for this. Bank borrowing occurs in response to need. Hence:

> " ... when a member bank receives a Federal Reserve check, put into the market through the purchase of government obligations, that bank will ordinarily use the check to liquidate borrowings from the Federal Reserve Bank rather than use it for a further extension of credit. In case the member bank receiving the check is not in debt at the Reserve Bank and therefore employs the funds by purchasing additional investments or making additional loans, the extra amount of credit thus put into the market usually finds its way promptly to some bank which is in debt at the Reserve Bank. Thus, the usual effect of a purchase of government securities by the Reserve Banks has been a corresponding reduction in the borrowing of member banks. The action has the effect, not of increasing the volume of credit, but rather of easing the pressure on the banks." (12, p. 236)

Therefore, even had the discount rate not been raised in 1931, those adhering to this view believed that open market purchases would be accompanied by a sharp reduction in member bank discounting, and perhaps in acceptances sold to the Reserve Banks, and hence in free gold. That free gold was too slight to bear this additional strain was accepted as a matter of course. Some who wrote during the depression era were not overly disturbed by the existence of this constraint, for they were opposed to the extensive use of open market operations and/or to the use of government securities as collateral for Federal Reserve notes. Most writers, however, would have favored a change in the law and an easy money campaign at an earlier date.

Years later, three men who had been Reserve System officials during the 1930's expounded their views on the severity of the free gold problem

during the critical months of 1931. Wrote Burgess,[1] (12, pp. 285-86) "The power of the Reserve System to ... purchase ... government securities was limited by the collateral provisions for Federal Reserve notes, which left the Reserve Banks with little free gold not locked up behind Federal Reserve notes." The views of Woodlief Thomas (43), Assistant Director of the Board's Division of Research and Statistics, were in precise agreement with those of Burgess. Goldenweiser (20), Thomas' superior in the Division of Research and Statistics, agreed that the collateral requirements constituted a serious constraint, but his exposition of the problem differs in one important respect. He wrote:

> "If the System had purchased substantial amounts of government securities so as to ease the position of member banks, this would have made it possible for them to reduce their indebtedness to the Reserve Banks. Desirable as such a reduction of debt would have been in itself, it would have had the incidental and irrational result of diminishing available collateral for Federal Reserve notes. The Federal Reserve Banks would have had to use gold to replace the collateral and a shortage of gold available as reserves against Federal Reserve deposits would have developed.
>
> "It is probably true, as has been asserted by critics, that a full-fledged easing policy by the System at that time might have mitigated the disasters of subsequent years. But such a policy, on a sufficient scale to be significant, would have involved a suspension of reserve requirements against Federal Reserve deposits. This the authorities at that time were not mentally prepared to contemplate.
>
> "Whether an extremely bold and far reaching policy of easing at that time could have changed the course of events is debatable; that it could not have been put into effect is beyond dispute." (20, pp. 159-61)

Never, within the pages of his book, does Goldenweiser refer to the free gold problem <u>per se</u>. The shortage which he most anticipated was in

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[1]Former Vice-President of the Federal Reserve Bank of New York.

the reserve against deposits, rather than in free gold. The two are closely related, but are distinguishable. On the likelihood of open market purchases resulting in a shortage of reserves against deposits, we shall have more to say in a later chapter.[1]

Regardless of the fact that Goldenweiser and Burgess were writing after their associations with the Reserve System had terminated, one might suspect that their viewpoints on the free gold problem had been colored by those associations. However, a number of their contemporaries concur in the general conclusions of these former Federal Reserve officials.

"It is undeniable that large open market purchases of securities before the passage of the Glass-Steagall Act in February, 1932, would have put a strain on the gold reserves of the Federal Reserve System," Villard (50, p. 728) admits, "but it is not clear that it was impossible for the System to maintain its acceptance portfolio." Villard contends that a reduction in acceptance rates would have been desirable, although he concedes that such a policy in itself would have been far from sufficient to turn the monetary tide and that "there was little that the Reserve System could have done ... that would not have further reduced its margin of free gold." (50, p. 737) Paris (32) agrees that free gold constituted a problem, but his commitment to this view is rather vaguely expressed. To the present, numerous authorities on monetary history continue to emphasize the restraining role of free gold on monetary policy in late 1931. For example, Studenski and Kroos (42, p. 368) state that

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[1] See p. 86.

collateral requirements "constituted a serious threat to continued expansion of the currency."

The most prolific writer on the free gold problem was Benjamin Anderson (1, 2, 3, 4 and 5), who from early 1930 issued constant warnings that free gold was insufficient to support a cheap money policy. Anderson also belonged to the school which opposed an aggressive open market program on general principles at this time. Relief to the strain on bank reserves should come through liquidation of bank credit, Anderson maintained. A general readjustment was needed, and artificially cheap money might lead to a temporary revival of business, but not to a general rectification of conditions. Furthermore, being a disciple of the "real-bills" doctrine, Anderson was disturbed by suggestion that collateral requirements be altered. "The law," he stated,

> "contemplates an elastic Federal Reserve note issue, automatically adjusted to the needs of trade through being linked with the holdings of commercial paper by the Federal Reserve System .... But the law very properly refuses to allow Federal Reserve notes to be issued against Government securities purchased by the Federal Reserve Banks, which have no relation to the needs of trade." (2, p. 4)

Anderson's attitude toward collateral requirements was not unique with him. Most monetary traditionalists held similar beliefs. Writing several months before Britain suspended gold payments, Beckhart (8) mentioned that proposals for permitting the use of government securities as collateral had been put forth. He declared in utter amazement:

> "That anyone would seriously consider this proposal, the coinage of government obligations into currency, seems inconceivable. One of the primary purposes of the Federal Reserve Act was to do away with a government bond-secured note issue ...." (8, p. 149)

By the time the Glass-Steagall Act was passed, Anderson had moderated his views. He conceded that the bill was "justified as a temporary emergency measure .... We had already had a very heavy liquidation of credit in 1931 and early 1932. It was undesirable to liquidate further, if we could avoid it, and the Glass-Steagall Bill, enabling us to use our vast gold resources more freely and with less technical difficulty, was a useful and helpful emergency measure." (5, p. 11) In his financial history (1), published almost 20 years later, we find a further evolution in Anderson's thinking -- there he laments the fact that the Federal Reserve Banks could not engage in open market purchases in the fall of 1931.

Harris (27, p. 380) agreed with Anderson's earlier position that the free gold of the System "was not large enough to allow the unrestricted purchase of securities" but that a tight money policy was in order during the disastrous autumn of 1931, regardless of the free gold position. Higher discount rates and stable holdings of governments would force banks to economize on their resources and to borrow no more than they absolutely needed -- desirable results, in Harris' opinion.

There were still others who opposed the use of open market operations in general. Whitney (51, p. 68) asserted that "the greatest obstacle to effective discount policy has been the excessive use of open market operations as separate instruments of control." Willis (52) considered open market operations as a kind of "forced feeding" which was unlikely to have much success. Hardy (24, p. 274) agreed that the supply of free gold had been seriously depleted and that "there was real danger that further with-

drawals, especially on the part of France, might result in embarrassment for the Reserve Banks." However, there would have been no need for the Glass-Steagall Act had the System not encouraged the unfortunate tradition against borrowing, and had it been willing to retain lower discount rates in late 1931, Hardy maintained. He would have much preferred the stimulation of credit through the use of the discount window to open market operations, which he claimed were never intended to be more than a supplemental device.

A mere handful of those who wrote on economic policy during the depression decade contended that an aggressive purchase program could have been carried out in the fall of 1931. Writing just prior to the British departure from gold, Rogers (40, p. 208) complained that the Federal Reserve Banks had been acting as "gigantic sponges continually soaking up the ever inflowing golden flood." Monetary authorities, he warned, "must either use their great 'open market' powers to arrest damaging price declines, or else must face highly deserved criticism." Since this was written before the tremendous raid on U. S. gold commenced, it loses much of its force, however. Hawtrey (28, pp. 241-42) believed that the System could have bought governments in much greater volume, even during the months immediately preceding the passage of the Glass-Steagall Act. However, Hawtrey apparently misinterpreted the gold requirements to which the Reserve Banks were subject, for he mistakenly asserted that government securities could be held against deposits in Reserve Banks and that the acquisition of more governments would release gold unless note circulation consequently increased. Among latter-day historians who have accepted the

Friedman-Schwartz argument are Robertson (38) and Horvitz (30, p. 396), who acknowledge that these authors "present convincing evidence that the gold reserve argument was only a rationalization and not a real reason for Federal Reserve failure to adopt a vigorous easy money policy."

With few exceptions, those who were familiar with the determinants of free gold in the 1930's, and who wrote on the subject, accepted it as a matter of course that extensive open market operations between September, 1931, and February, 1932, would have had disastrous repercussions on the System's free gold position. This opinion was held by those who had faith in the efficacy of such operations in general as a means of controlling economic fluctuations, as well as by those who regarded this powerful new tool as one which would have been best left undiscovered.

Outline of the Study

The primary object of the chapters which follow is to determine whether the barrier which depression era economists believed the free gold shortage created for a vigorous open market policy was real or illusory. More specifically, we will investigate the Friedman-Schwartz contentions that a $1 billion purchase could have been undertaken in late 1931 without endangering the free gold position, and that an operation of this size would have been sufficient to stabilize the money stock.

In Chapter II free gold is defined in a more rigorous way, both verbally and symbolically, and a set of assumptions regarding some of the determinants of that quantity is put forth. Chapter III presents a simple model of bank portfolio behavior which will subsequently be utilized in predicting, under the assumption of a $1 billion open market purchase,

hypothetical values of member bank borrowings, acceptance holdings, and loans -- the first two variables being important determinants of free gold, while the third has a great influence on the money stock. The results of empirical tests of the model for the period 1930 to 1935 are provided in Chapter IV. Chapter V contains the most important findings of this study. In this chapter we present our conclusions, and the methods used to obtain them, as to the effect of a $1 billion purchase of governments on free gold and on the money supply. In addition, we investigate the extent to which the System could have pursued the other alternatives for easing the free gold position which Friedman and Schwartz claim were available. Finally, a brief discussion of the more qualitative reasons which led Friedman and Schwartz to their conclusion that free gold exerted no "major influence on Federal Reserve policy" (18, p. 401) is given. The final chapter presents a summary of our investigation and some concluding observations.

CHAPTER II. THE DETERMINANTS OF FREE GOLD

In Chapter I, we discussed free gold and the factors affecting it in a very general way. This chapter will describe the determinants of this much-debated concept more thoroughly, and will develop the equations to be used in predicting the hypothetical effect on free gold should the monetary authorities have embarked on an open-market purchase program in late 1931. Specific assumptions as to the effect of security purchases on some of the determinants of free gold are outlined. Finally, we analyze the implications for free gold of the particular assumptions made by Friedman and Schwartz.

The term "free gold" meant gold and gold certificates held by the Federal Reserve Banks that was not required either as reserves or as collateral for Federal Reserve notes. Free gold was calculated by deducting from Reserve Bank gold reserves the gold necessary to meet the following requirements:

1. A 35 percent reserve in gold or lawful money against deposits. All deposit liabilities of Federal Reserve Banks -- member bank, government, foreign bank, and other -- were subject to the reserve requirement. Lawful money, which could be used in satisfying the requirement, consisted of standard silver dollars, silver certificates and legal tender notes.
2. A 40 percent gold reserve against Federal Reserve notes. Federal Reserve notes subject to this requirement included all notes issued to the Reserve Banks by the Federal Reserve Agent, except those notes held in the vaults of the issuing banks. Therefore, reserves were

required against notes held by Reserve Banks other than the bank of issue and by the Treasury, as well as against notes held by the public.

3. 100 percent collateral in gold or eligible paper against Federal Reserve notes issued to the Reserve Banks by the Federal Reserve Agent. Note that this requirement applied to all notes issued to the Reserve Banks, including those held as till money in the issuing Banks. Eligible paper consisted of discounts and acceptances purchased in the open market. It was this collateral requirement which was altered by the Glass-Steagall Act of February, 1932. Under its provisions, the Reserve Banks were authorized to include government securities as collateral against Federal Reserve notes.

   Gold pledged as collateral also constituted a part of the Reserve Bank reserves, but could be counted as reserves only against Federal Reserve notes and not against deposits. Hence, the gold pledged to satisfy collateral requirements served at the same time to satisfy Requirement 2. In fact, because gold required as collateral was always considerably greater than the 40 percent required against notes, the latter requirement did not enter separately into the calculation of free gold.

4. A gold redemption fund in the U. S. Treasury equal to at least 5 percent of notes not covered by gold collateral. The volume of notes not covered by gold was considered to be the amount of eligible paper pledged. This was not equal to total collateral required less

gold pledged, because the Reserve Banks always pledged somewhat more collateral than was absolutely necessary to meet the requirement.[1]

Symbolic Definition of Free Gold

Free gold as defined in the preceding paragraphs can be written symbolically as:

$$(2.1) \quad G_F = R_F - G_C - .35D_T - .05E_P$$

where:

G_F = free gold

R_F = total reserves of Reserve Banks = gold and gold certificates + lawful money[2]

G_C = gold required as collateral against Federal Reserve notes

D_T = total deposit liabilities of Federal Reserve Banks

$.35D_T$ = reserves required against deposits

E_P = eligible paper pledged as collateral against Federal Reserve notes

$.05E_P$ = gold required for the redemption fund with the U. S. Treasury

We can further specify that:

$$(2.2) \quad G_C = N_I - E_P$$

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[1] Excellent discussions of the free gold concept are provided in System publications such as (48, 1932, p. 16-18) and (49, 1932, pp. 143-44).

[2] If lawful money were larger than reserves required against deposits this formulation would overstage free gold since it would imply that the excess lawful money could be used to satisfy other requirements. Lawful money was, for the period we are considering, so small that this situation never arose.

where:

N_I = volume of Federal Reserve notes issued by the Federal Reserve Agent to the Reserve Banks.[1]

In discussions of Federal Reserve policy, one widely used identity is that member bank reserves equal sources of reserve funds minus competing uses of reserve funds. This identity can be written as:

$$(2.3) \qquad D_M = B_F + A_F + G_S + OR + MG + TC - C - T - OA - D_G - D_N$$

where:

D_M = member bank deposits with Federal Reserve Banks = member bank reserves

B_F = bills discounted and advances made by Reserve Banks

A_F = bills (bankers' and trade acceptances, and acceptances payable in foreign currencies) bought by Reserve Banks

G_S = government securities held by Reserve Banks

OR = other Reserve Bank credit

MG = monetary gold stock

TC = Treasury currency

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[1] It can be shown that there is nothing to be gained by including reserves required against notes as a separate component in the free gold equation. Let:

G_N = reserves required against notes = 40 percent of notes outside issuing Reserve Banks

G_{C_1} = gold collateral needed in addition to the reserve against notes

$= N_I - G_N - E_P$.

Then:

$$G_C = G_N + (N_I - G_N - E_P) = N_I - E_P.$$

C = currency in circulation

T = Treasury cash

OA = other Federal Reserve accounts

D_G = Treasury deposits with Federal Reserve Banks

D_N = non-member bank deposits with Federal Reserve Banks

The sum of the items with positive signs equals total sources of member bank reserves, while the sum of the negatively-signed elements equals total competing uses of these funds.

Total deposit liabilities of Federal Reserve Banks, D_T, is defined as $D_G + D_N + D_M$. Using this equality, and rearranging terms in Equation 2.3, we obtain:

$$(2.4) \qquad D_T = D_G + D_N + D_M = B_F + A_F + G_S + MG + O - C$$

where:

$$O = OR + TC - T - OA$$

Reserves required against deposits can now be expressed as:

$$(2.5) \qquad .35D_T = .35(B_F + A_F + G_S + MG + O - C)$$

Two additional definitions which will be used are:

$$(2.6) \qquad C = C_F + C_O$$

where:

C_F = Federal Reserve notes in circulation

C_O = other currency in circulation

and

$$(2.7) \qquad N_I = C_F + C_R$$

where:

C_R = Federal Reserve notes issued to Federal Reserve Banks but not in circulation, i.e., notes held by Reserve Banks and by the U. S. Treasury

Substituting Equations 2.2, 2.5, 2.6 and 2.7 into 2.1 yields:

$$(2.8) \quad G_F = R_F - (C_F + C_R - E_P) - .35(B_F + A_F + G_S + MG + O - C_F - C_O) - .05\ E_P$$

$$= R_f - .65\ C_F - C_R + .95\ E_P - .35(B_F + A_F + GS + MG + O - C_O)$$

Assumptions Regarding the Free Gold Variables and Their Implications

It is our aim to predict the change in free gold which would have obtained had a $1 billion open market campaign been undertaken in late 1931. In this section assumptions as to the determinants of some of the variables in the free gold equation are specified and from these, more specific equations for predicting the alteration in the free gold position are derived. These equations have some rather interesting implications for the level of free gold which are discussed at the conclusion of this section.

Taking the first difference of Equation 2.8, a change in the value of free gold is defined as:

$$(2.9) \quad \Delta G_F = \Delta R_F - .65\ \Delta C_F - \Delta C_R + .95\ \Delta EP - .35(\Delta B_F + \Delta A_F + \Delta G_S + \Delta MG + \Delta O - \Delta C_O)$$

An increase in any one of the positively signed items will, ceteris paribus, improve the free gold position, while the enlargement of an element with a negative sign will contribute to a reduction in free gold.

The value of G_S, government security holdings of the Reserve Banks, is determined by the monetary authorities. Other things equal, a purchase of the size suggested by Friedman and Schwartz would have reduced free gold by $350 million. The ceteris paribus assumption is not too unrealis-

tic when applied to R_F, MG and O. It is improbable that the gold stock, MG, would have been greatly affected by Federal Reserve open market purchases in late 1931. Such purchases would have had little effect on the already abnormally low short-term interest rates, and therefore on international capital flows. Any rise in income and prices produced by the easy money policy might have contributed to an expansion of imports relative to exports, and hence to an acceleration of the gold outflow, but since international trade had all but disintegrated by this time, such effects were likely to be minor. The primary determinant of gold outflows in late 1931 was undoubtedly the fear generated by the collapse of the gold standard in Britain. Unless foreign creditors would have viewed an aggressive monetary policy in this country as an additional threat to the maintenance of the gold standard, such a policy should not have contributed to their panicky demands for gold. Hence, we will postulate that the augmentation of Reserve Bank security holdings would have produced no significant change in the monetary gold stock. In a later chapter we consider the implications of relaxing this assumption.

The gold reserves of the Reserve Banks, which comprised more than 90 percent of their total reserves, R_F, were highly correlated with changes in the gold stock -- in fact, the Reserve Banks held the vast majority of U. S. gold. Therefore, we maintain that R_F, as well as MG, would have suffered no serious deterioration from a $1 billion purchase.

The quantity designated by O exhibited very little change over the entire period from 1928 to 1932. Since this element is a conglomerate derived from the values of Other Federal Reserve Accounts, Other Federal

Reserve Credit (mainly float), Treasury Cash and Treasury Currency, it is necessarily affected by a multitude of factors. The most logical procedure is to assume that O is another variable which is unaffected by Federal Reserve open market operations.

Most of the Federal Reserve notes issued but not in circulation, C_R, were held in the vaults of the issuing Reserve Banks. Harris (27, p. 770) discusses the factors which governed the volume of such counter cash:

> "In periods when reserve officials are concerned with the problem of the adequacy of free gold, they are inclined to economize on their tills and thus release gold, as an examination of the movements in 1931-32 will reveal. On the other hand, the extent of the fluctuations in the demand for currency is necessarily an important factor in the determination of the notes held in tills by reserve banks."

The level of till money was, then, a function of expected currency demand and of the free gold position. Bankers, including central bankers, frequently operate according to certain rules-of-thumb. A logical rule for the Reserve Banks to have followed in this case would have been to maintain the ratio of vault cash to Federal Reserve notes at or above some minimum level -- this ratio being determined at each point in time on the basis of expected currency flows. Whether or not the ratio fell to its minimum value would depend on the strains on free gold. The lowest point to which the ratio of C_R to C_F fell during the years 1928 to 1932 was 10 percent in January, 1932.

Because the System claimed to be doing everything possible to relieve the free gold problem at this time, one would expect that C_R/C_F was approaching its minimum acceptable value. Therefore, as one alternative

in predicting the hypothetical value of free gold for late 1931, a 10 percent floor on this ratio will be assumed.[1] However, in view of a Federal Reserve Board statement in its Annual Report for 1932, this may be assuming too high a value. In discussing the situation on February 24, 1932, the Board explains that free gold could have been

> " ... increased somewhat by reducing the volume of Federal Reserve notes held by the Federal Reserve banks in their own vaults, but even after that volume was reduced to the minimum required as an operating matter, the free gold would have been $542,000,000." (48, 1932, p. 18)

Since free gold was $416 million on February 24, the Board is implying that free gold could have been increased by $126 million through the return of notes to the Federal Reserve Agent. Because there was a 1 to 1 relationship between free gold and Federal Reserve notes held in the vaults of Reserve Banks, this in turn implies a reduction of $126 million in such holdings. The ratio of C_R to C_F would have consequently declined to approximately 6 percent. Of course, since seasonal currency demands would have been lower in February than during the fall and winter, the minimum ratio considered essential was probably correspondingly lower on the February date. However, it does seem of interest to predict the change in free gold under each of these possibilities for $C_R{:}C_R{=}.1C_F$ and $C_R{=}.06C_F$.

The amount of eligible paper pledged, E_P, was always less than the amount of such paper held by the Reserve Banks. The reason for this was apparently to minimize time-consuming bookkeeping adjustments. Federal Reserve Banks purchased only "seasoned bills," i.e., those which had been

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[1] The actual ratio was 12 percent at the end of 1931.

in the market for some time and were approaching maturity. At the end of 1931, for example, the maturity of almost 80 percent of the eligible paper held by the Reserve Banks was less than 15 days (48, p. 71). Had all eligible paper held been pledged, it would obviously have necessitated quite frequent withdrawals and deposits of collateral simply to eliminate matured bills from the Reserve Agent's collateral holdings. Over the period January, 1928, to June, 1932, the largest ratio of eligible paper pledged to eligible paper held was .986 in May, 1930, when eligible paper maturing within 15 days comprised only 60 percent of paper held. The mean ratio over the interval was approximately .95, which was also its value for the fourth quarter of 1931. This is the ratio which will be used in predicting the effect on free gold of the hypothetical security purchase.

The estimate of the effect on currency in circulation due to the hypothetical security purchase to be used throughout this paper is that value implied by the assumptions of Friedman and Schwartz. Equation 2.10 is reported by the authors (18, p. 791) to be "the basic equation that we have used in most of our analysis of the factors affecting the money stock":

$$(2.10) \qquad M = H\left[\frac{D/R(1+D/C)}{D/R + D/C}\right]$$

where:

M = money stock

H = high-powered money

D = deposits of commercial banks

R = bank reserves

C = currency held by the public

In order to determine C, we need hypothetical values of M, H, D/R and D/C. These are provided by Friedman and Schwartz. Had discounts and bills bought remained constant between August, 1931, and January, 1932, "a purchase of $1 billion of government securities would have meant a rise in high-powered money by $650 million more than the actual rise." (18, p. 399) Since the actual value of H in January, 1932, was $7.704 billion, the hypothetical value becomes $8.354 billion. Furthermore, assuming that the actual deposit-reserve ratio of 11.28 in January, 1932, was unchanged by the open market purchase, an improvement in the deposit-currency ratio to 7.10 "would, under these hypothetical circumstances, have enabled the stock of money to be stable instead of falling by 12 percent." (18, p. 399) Substituting these values for H, D/R and D/C into Equation 2.10 yields:

$$(2.11) \qquad M = \$8.354 \text{ billion } \frac{11.28\ (1 + 7.10)}{11.28 + 7.10} = \$41.525 \text{ billion}$$

We are given (18, p. 791) that:

$$(2.12) \qquad H = C + R$$

$$(2.13) \qquad M = C + D$$

Therefore, we can write:

$$(2.14) \qquad D/R = \frac{M - C}{H - C} = k$$

$$(2.15) \qquad M - C = k\ (H - C)$$

$$(2.16) \qquad M - kH = (1 - k)\ C$$

and finally:

$$(2.17) \qquad C = \frac{M - kH}{1 - k} = \frac{M - D/R\ (H)}{1 - D/R}$$

Inserting Friedman's assumed values for D/R, M,and H into 2.17, we find that:

$$(2.18) \qquad C = \frac{\$41.525 \text{ billion} - (11.28)\ (\$8.354 \text{ billion})}{1 - 11.28} = \$5.127 \text{ billion}$$

Friedman's estimates of currency in circulation are seasonally adjusted, whereas the components of free gold in Equation 11 are not. However, we would not expect the use of seasonally adjusted data to have much effect on the hypothetical change in C as a result of the open market purchase. The difference between the hypothetical and the actual values of C for January, 1932, can be considered as the effect on C of the purchase program. This difference is $231 million. Since the bank portfolio data needed for predicting borrowings and acceptances (two crucial components of free gold) is available for December 31, 1931, but not for January, 1932, our predictions will apply to a hypothetical $1 billion purchase completed by the end of 1931 rather than a month later, as Friedman and Schwartz assume. However, we will postulate that the effect on currency in circulation would have been the same regardless of whether the program were terminated in December or January. This assumption implies that had Reserve Bank security holdings risen between August and December, 1931, by $1 billion, currency in circulation would consequently have expanded by $231 million.

The equation for free gold contains the components of currency in circulation, C_F and C_O, rather than C alone. It seems unlikely that the proportional relationship between Federal Reserve notes and other forms of currency held by the public would be greatly disturbed by a large open market purchase. Therefore, it is assumed that this ratio is exogenously determined. At the close of 1931, C_F comprised 49 percent of total currency in circulation.

The assumptions made regarding the changes in R_F, MG, O, C_F, C_R, E_P and C_O which would have resulted from a late 1931 open market operation of $1 billion dollars are summarized in Equations 2.19 through 2.25b.

(2.19) $\Delta R = 0$

(2.20) $\Delta MG = 0$

(2.21) $\Delta O = 0$

(2.22) $\Delta C_F = .49(\$231 \text{ million}) = \$113.19 \text{ million}$

(2.23) $\Delta C_O = .51(\$231 \text{ million}) = \$117.81 \text{ million}$

(2.24) $\Delta E_P = .95\ \Delta E_H = .95(\Delta B + \Delta A)$

where E_H = eligible paper held by Federal Reserve Banks = $B_F + A_F$

(2.25a) $\Delta C_R = .1(\$2{,}716 \text{ million}[1]) - \$323 \text{ million} = -\$51 \text{ million}$

(2.25b) $\Delta C_R = .06(\$2{,}716 \text{ million}) - \$323 \text{ million} = -\$160 \text{ million}$

Substituting Equations 2.19 through 2.25a into Equation 2.9, we obtain the following expression for the hypothetical change in free gold:

(2.26) $\Delta G_{F_a} = -.65(\$113.19 \text{ million}) - (-\$51 \text{ million}) + .95\ [.95(\Delta B_F + \Delta A_F)] - .35(\Delta B_F + \Delta A_F + \$1{,}000 \text{ million} - \$117.81 \text{ million})$

$= -\$331.34 \text{ million} + .5525\ (\Delta B_F + \Delta A_F)$

If we replace 2.25a with 2.25b, which implies greater economizing on till money at Reserve Banks, the predicted change in free gold becomes:

(2.27) $\Delta G_{F_b} = -.65(\$113.19 \text{ million}) - (-\$160 \text{ million}) + .95\ [.95\ (\Delta B_F + \Delta A_F)] - .35(\Delta B_F + \Delta A_F + \$1{,}000 \text{ million} - \$117.81$

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[1] The value of C_F on December 31, 1931 was $2,603 million. Hence, the hypothetical value of C_F becomes $2,716 million.

million)

$$= -\$222.34 \text{ million} + .5525(\Delta B_F + \Delta A_F)$$

These results are very interesting in themselves. The value of free gold at the end of 1931 was approximately $600 million. There are no official published figures on free gold, but the chart from which Chart 1 was taken appeared in the Board's Annual Report for 1932 (48, 1932, p. 17) Even with no change in borrowings or Federal Reserve acceptance holdings, our estimates are that free gold would have declined to a point between approximately $375 million and $270 million as the result of the open market purchase. The lowest point to which free gold dipped during the months immediately preceding the passage of the Glass-Steagall Act was approximately $400 million in February, 1932, and this was the least it had been for 10 years. Hence, even if the purchase did not adversely affect discounting and bills bought by the System, free gold would have declined to an abnormally low level.

The Implications for Free Gold of the Friedman-Schwartz Assumptions

Friedman and Schwartz (18, p. 399) explicitly assume that their hypothetical purchase would have reduced the actual level of borrowings in January, 1932, by $560 million and would have resulted in an increase in System holdings of acceptances on that date of $210 million. Hence, the volume of eligible paper in the possession of the Reserve Banks would have been depleted by $350 million, and would have settled at its August, 1931, level. Furthermore, by January, the date to which the Friedman-Schwartz calculations apply, the actual volume of Federal Reserve notes in

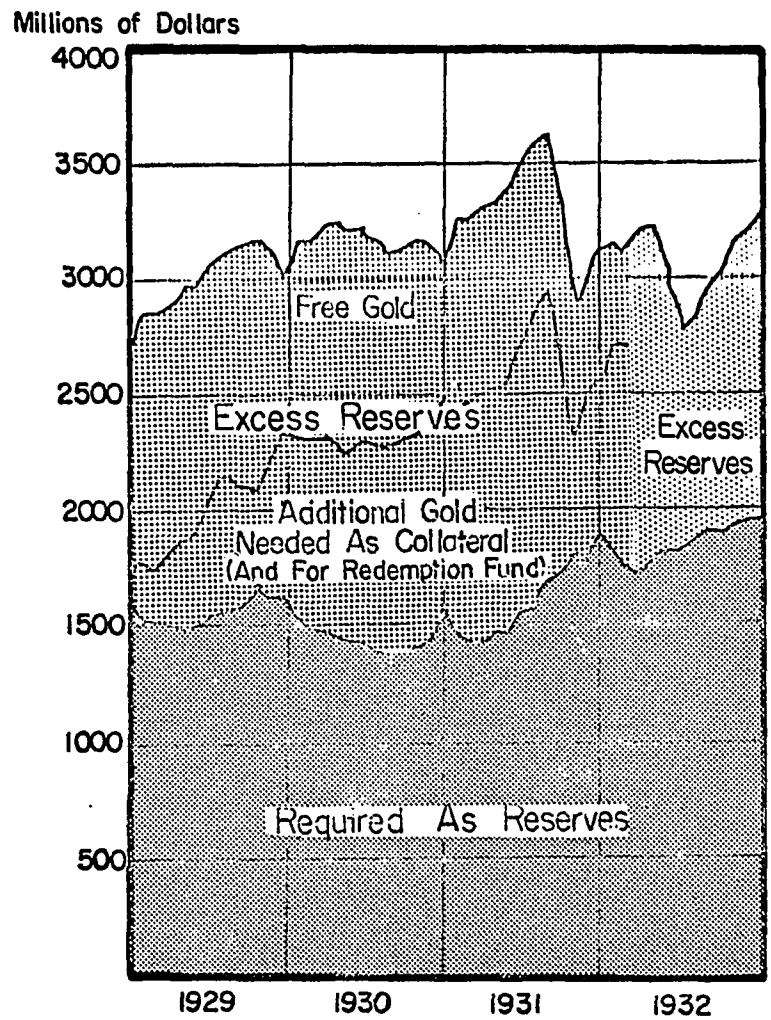

Chart 1. Reserves of Federal Reserve Banks (49, 1932, p. 17)

circulation had climbed above its December value, while at the same time a substantial reduction -- from $323 million to $275 million -- in Reserve Bank counter cash had been made. The possibility of further economizing on tills was therefore much less in January than in December. If we add to the actual volume of Reserve notes in circulation, the expected change of $231 million due to the purchase program, Federal Reserve notes in circulation[1] rise to $2,762 million. The change in C_R would have been a positive $1 million under an assumption of $C_R = .1C_F$, or a negative $110 million if C_R could have been reduced to a mere 6 percent of Reserve notes in circulation. Using these estimates, the change in free gold implied by the Friedman-Schwartz assumptions becomes, under the two alternatives for C_R, that given in 2.28 and 2.29.

(2.28) $\Delta G_{F_{a,F}}$ = -.65($114 million) - ($1 million) + .5525(-$350 million) -.35($883 million)[2]

= -$577.53 million

(2.29) $\Delta G_{F_{b,F}}$ = -.65($114 million) - (-$110 million) + .5525 ($350 million) -.35($883 million)

= -$466.53 million

Free gold at the end of January, 1932, was approximately $450 million. Therefore, a decline of the magnitude shown in Equation 2.28 would have

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[1] Outside the U. S. Treasury and Federal Reserve Banks.

[2] $C_{F/C}$ was slightly greater in January, 1932, than it had been in December, 1931. Hence, the values for C_F and C_O in Equations 2.28 and 2.29 differ a bit from their counterparts in 2.26 and 2.27.

resulted in a negative value for free gold. Even with the greater economy of till money assumed in 2.29, free gold would have been completely eliminated.

It is almost inconceivable that, given their assumptions as to the changes in B_F, A_F and C, Friedman and Schwartz could have predicted any lesser change in free gold. Certainly the variables held constant, R_F, MG and O, would not have risen in response to the purchase -- in fact, R and MG, as noted above, might have declined. There is little reason to expect any alteration in the relationship of C_F to C_O which would have favorably affected free gold. Even if the proportion of eligible paper holdings pledged as collateral could have been increased by 1 or 2 percent, this would have augmented free gold by only a few million dollars. Hence, Friedman and Schwartz appear to be in the peculiar position of maintaining that a zero or negative level of free gold was sufficient in January, 1932.

Our primary object is not, however, the discovery of the implied value of free gold under the Friedman-Schwartz assumptions, but rather to predict the consequences for free gold and the money stock of the policy which they suggest. To achieve this end we need estimates of ΔB_F and ΔA_F for Equations 2.26 and 2.27. We cannot simply accept the assumed values presented by Friedman and Schwartz, for they provide no explanation of the method used to derive these values. Furthermore, we must develop some estimate of the change in the deposit component of the money supply, having accepted the currency rise postulated by Friedman and Schwartz. The task of developing a theoretical framework which can aid in the explanation of ΔB and ΔA, as well as the change in bank loans, which

is a crucial determinant of bank deposits, is undertaken in the following chapter.

CHAPTER III. A SIMPLE MODEL OF BANK PORTFOLIO BEHAVIOR

The purpose of this chapter is to develop at the microeconomic level a model of bank portfolio behavior which can be used to explain borrowings from Reserve Banks, acceptance holdings and loans granted by commercial banks during the early 1930's.

We assume that the banker makes decisions at time t whose objective is to maximize expected profits between t and t+1. However, he operates under certain constraints. The bank must maintain sufficient primary and secondary reserves to meet expected seasonal and other regular demands on its resources from depositors and from borrowers. This requirement will be termed the liquidity constraint. Secondly, the bank must be in a position to withstand any conceivable strain that may be placed upon it, such as the withdrawal of deposits occasioned by the unexpected departure of a large commercial customer, and still remain in business. We will define this necessity as the soundness constraint. Finally, any decision the banker makes must conform to the accounting identity that assets minus liabilities equal capital funds.

Expected Profits

In general, expected profits are increased by holding assets such as government securities, loans, short-term paper and long-term bonds. Borrowing from the Reserve Banks reduces expected profit. The expected profit equation can be written as:

$$(3.1)\quad E[\pi] = E[r_A]\,A + E[r_{U_B}]\,U_B + E[r_S]\,S + E[r_{U_G}]\,U_G + E[r_{U_N}]\,U_N + E[r_M]\,M + E[r_R]\,R + E[r_U]\,U + E[r_P]\,P + E[r_L]\,L + E[r_B]\,B$$

where:

$E[\pi]$ = expected profits between t and t+1

A = value of bankers' acceptances held at t

U_B = value of U. S. Treasury bills held at t

S = value of loans to brokers and dealers at t

U_G = value of U. S. Treasury bonds held at t

U_N = value of U. S. Treasury notes held at t

M = value of municipal bonds held at t

R = value of railroad bonds held at t

P = value of commercial paper (four to six months) held at t

L = value of loans to customers held at t

B = borrowings from Reserve Banks held at t

$E[r_A]$, $E[r_{u_B}]$,..., $E[r_B]$ = expected rate of return on each variable, A, U_B ,... ,B, respectively

For simplicity, we assume that the only income-generating assets which the banker can hold are those specified in the expected profit function. Borrowing creates a cost, and consequently its rate of return is always negative. The only variable costs incurred by the banker are assumed to be those associated with borrowing at the Federal Reserve discount window.

No asset purchased by the banker at t matures prior to t+1 in this model. In empirical tests, a time horizon of three months is adopted. Although a shorter horizon might seem more realistic, this length was selected because data on bank portfolios for the 1930's is available only on a quarterly basis.

For assets which mature at t+1, the expected rate of return is known with certainty, and is simply one-fourth of the annual rate of interest which they bear. Of the assets included in the model, bankers' acceptances, Treasury bills, loans to brokers and dealers and to customers are placed in this category. We are assuming, in effect, that any of these assets selected for the bank's portfolio at t matures in precisely 90 days. This assumption may not be entirely realistic, but given the paucity of bank portfolio data for the depression period, it seems to be unavoidable. The expected rate of return on borrowings is also a known, and is equal to one-fourth the discount rate preceded by a minus sign.

Other assets in the model are treated as having a maturity greater than the time horizon. It is assumed that the banker's concept of income includes unrealized capital gains. Therefore, the expected rate of return on these investments must include the expected capital gain or loss in percentage terms, as well as the known rate of interest for the period.

The banker chooses at t the combination of variables in Equation 3.1 which will maximize his expected profits over the interval t to t+1, subject to liquidity, soundness and balance sheet constraints. This does not, however, imply that during the period t to t+1, he is locked into the particular portfolio which was chosen at t. With the passage of each moment of time, the banker revises his expectations and decides on a new portfolio based on his expected profits for a new time horizon of t to t+1.

The Liquidity Constraint

Bank liquidity is most frequently measured in terms of certain balance-sheet ratios, such as the ratio of loans to deposits or of

short-term assets to deposits. The former is a less satisfactory measure than the latter. The ratio of loans to deposits is intended to demonstrate the degree to which the bank has already used up its available resources to accommodate the credit needs of its customers. A low ratio supposedly indicates a high degree of liquidity. However, this standard would overestimate the liquidity position of a bank with an unusually large long-term bond portfolio. The ratio of short-term assets to deposits provides a better indication of the volume of bank assets which are easily convertible into funds with which to meet deposit withdrawals or to make additional loans.

It will be assumed that the banker measures his liquidity in terms of the short-term asset to deposit ratio, and that he maximizes expected profit subject to a constraint that this ratio attains some specified minimum level. If the banker operates under a time horizon of t to t+1, he will decide on an acceptable level of liquidity at t based on his expectations of loan demand and deposit withdrawals over this interval. Therefore, the liquidity constraint should take into account the banker's expectations. Since these are unknown, and would be particularly difficult to estimate for so volatile a period, it will be assumed that the minimum level of liquidity acceptable to the banker at a given point in time was the ratio actually obtained.

Numerous forms of the short-term asset deposit ratio, each with slight variations in the types of assets and deposits included, could be developed. The most reasonable form for our purposes seems to be the following:

$$(3.2) \qquad \frac{E + V + A + S + U_B + P - B}{TD + DD_N - RR}$$

where:

E = excess reserves with Federal Reserve Banks

V = vault cash

TD = time deposits

DD_N = net demand deposits

RR = reserves required against demand and time deposits

The numerator of 3.2 is composed of high-quality assets maturing within one year, less borrowings. It is therefore a measure of net liquid assets available for meeting potential needs. The quantity expressed by the denominator is the maximum reserve deficiency which the bank could face, i.e., the deficiency that would result should all deposits be withdrawn.

Let:

(3.3) v = 1 - reserve ratio against demand deposits

and:

(3.4) s = 1 - required reserve ratio against time deposits

Substituting 3.3 and 3.4 into Equation 3.2, we obtain:

$$(3.5) \qquad \frac{E + V + A + S + U_B + P - B}{DD_N - (1-v)\, DD_N + TD - (1-s)\, TD}$$

Demand deposits can be separated into two components: deposits created by loans, and other deposits. Define:

$$(3.6) \qquad DD_N = D_P + D_L$$

where:

$$D_P = DD_N - D_L$$

and:

D_L = deposits created in the process of granting loans = L

Equating the liability, deposits created by granting loans, with the asset loans, amounts to assuming that when a loan is granted the customer always receives a credit to his demand deposit account rather than currency or an addition to time deposits. This is probably not a radical distortion of reality, however.

Substituting 3.6 into 3.5 and writing the result in the form of a constraint which must meet a certain minimum level, α, yields:

$$(3.7) \qquad \frac{E + V + A + S + U_B + P - B}{v(D_P + D_L) + sTD} \geq \alpha$$

In estimating the model, D_P, TD, E and V will be considered as exogenously determined. These quantities cannot be altered by decisions of the banker at t. The decision as to the proportion of assets to hold in the highly liquid forms of excess reserves and vault cash is treated as one made separately from the allocation of the portfolio of income-earning assets. This is analogous to the procedure frequently employed in consumption theory which treats the consumer's choice of a bundle of goods to be consumed as independent from the decision of what proportion of income will be saved.

Deposits other than those created by the banker in the process of making loans are the result either of decisions by the non-bank public as to the division of its money stock between deposits and currency, or of bank acquisitions of earning assets other than loans. Total bank deposits will rise as the result of bank purchases of securities as the funds

received by the seller are placed in time or demand deposits. Generally, however, the bank making the investment could not expect that his bank would be the recipient of the proceeds. He would therefore logically assume that variations in his security holdings are uncorrelated with changes in his time and demand deposit liabilities. If the banker also operates under perfectly competitive conditions, it is unlikely that he will be able to alter his policies so as to attract a greater proportion of the deposit business or to influence the total volume of deposits held by the public. The individual banker would therefore be expected to view D_P and TD as exogenously determined variables. They are unaffected by any action he may take.

Transferring constants to the right-hand side of 3.7 results in:

$$(3.8) \quad A + S + U_B + P - B - \alpha\, vD_L \geq \alpha\, [vD_p + sTD] - E - V$$

Equation 3.8 is the form of the liquidity constraint which will be estimated.

The Soundness Constraint

The soundness of a bank is generally considered as synonymous with capital adequacy. As expressed by one author, bank capital funds are:

> " ... a factor, perhaps the most important factor, in maintaining the confidence a bank must enjoy to continue in business and prosper. The essential function of bank capital, in other words, is to keep the bank open and operating so that time and earnings can absorb losses; to inspire sufficient confidence in the bank on the part of depositors and the supervisor so that it will not be faced with costly liquidation." (13, p. 158)

One widely accepted measure of capital adequacy is the ratio of total capital accounts to risk-assets, called the risk-asset or risk ratio. In its simplest form, the denominator of the ratio includes all assets except

U. S. government securities, cash, and bank balances. The deduction of completely liquid assets such as cash and bank balances, and of government securities, recognizes the essentially riskless character of these assets. Of course, the risks inherent in other assets held by the bank are not uniform, and recently numerous risk-asset formulas have been developed which take into consideration the differences in degree of risk among bank assets. Lacking the data necessary to employ one of these more complex forms of analysis, however, we will have to be content with the simpler risk-asset ratio.

The risk ratio was first employed by the Federal government in analyzing capital adequacy during the late 1940's. At that time, it was a relatively new addition to banking terminology. The banker of the 1930's, however, could scarcely have avoided attaching great importance to solvency. It seems reasonable to assume that even if he did not overtly employ a risk-asset ratio in determining his degree of soundness, the banker acted <u>as if</u> he were constrained by a desire for a certain minimum ratio of capital to risk assets.

This constraint can be written as:

$$(3.9) \quad K \div (A + U_B + S + U_G + U_N + M + R + U + P + D_L + V + R_f + B_B + CIPC + O_1 - V - R_f - B_B - CIPC - U_B - U_G - U_N)$$

$$= K \div (A + S + M + R + U + P + D_L + O_1) \geq \beta$$

where:

K = capital funds

R_f = reserves with Federal Reserve Banks

B_B = balances with other banks

CIPC = cash items in the process of collection

O_1 = other assets

β = minimum acceptable risk-asset ratio

It is assumed that K and O_1 at any point of time are given. Considering K to be a constant amounts to forcing the banker to make necessary adjustments in the risk ratio by adjusting his asset portfolio rather than by issuing additional capital stock. According to Robinson, the former procedure is generally recommended for sound bank management (39, p. 436).

Because the uncertainties of the 1930's make prediction of β an extremely difficult problem, the same assumption will be employed as for α -- that the minimum acceptable level was that actually attained.

Collecting all constant terms in 3.9 on the right-hand side of the equation, the soundness constraint can be written as:

(3.10) $A + S + M + R + U + P + D_L \leq K/\beta - O_1$

The Accounting Identity

The banker operates subject to one more constraint -- the value of his assets must equal the value of his liabilities plus capital accounts. We write this constraint as:

(3.11) $E + RR + A + U_B + S + U_C + U_N + M + R + U + P + L - B - DD_N - TD + O_2 = 0$

where:

O_2 = other assets - other liabilities - capital

It has been determined that:

(3.12) $RR = (1-v)\ D_L + (1-v)\ D_P + (1-s)\ TD$

(3.13) $L = D_L$

(3.14) $D_P = DD_n - D_L$

Substitution of Equations 3.12, 3.13 and 3.14 into 3.11 yields:

(3.15) $E + (1-v)\ D_L + (1-v)\ D_P + (1-s)\ TD + A + U_B + S + U_G + U_N + M + R + U + P + D_L - B - D_L - D_P - TD + O_2 =$

$E + (1-v)\ D_L - vDP - sTD + A + U_B + S + U_G + U_N + M + R + U + P - B + O_2 = 0$

Variables which are considered to be exogenously determined are E, D_P, TD and O_2. Moving these terms to the right side of Equation 3.15 we have:

(3.16) $(1-v)\ D_L + A + U_B + S + U_G + U_N + M + R + U + P - B = vD_P + sTD - O_2 - E$

The model to be estimated now consists of four equations:

(3.1) $E[\pi] = E[r_A]\ A + E[r_{u_B}]\ U_B + E[r_S]\ S + E[r_{u_G}]\ U_G + E[r_{u_N}]\ U_N + E[r_M]\ M + E[r_R]\ R + E[r_U]\ U + E[r_P]\ P + E[r_L]\ L + E[r_B]\ B$

(3.8) $A + S + U_B + P - B - \alpha\ vD_L \geq \alpha\ [vD_P + sTD] - E - V$

(3.10) $A + S + M + R + U + P + D_L \leq K/\beta - O_1$

and:

(3.16) $(1-v)\ D_L + A + U_B + S + U_G + U_N + M + R + U + P - B = vD_P + sTD - O_2 - E$

The banker maximizes Equation 3.1, the expected profit function, subject to 3.8, 3.10 and 3.16, the liquidity, soundness and balance sheet constraints, respectively. In the next section, we describe the technique used for testing this model, and the empirical results obtained when it was used to explain the portfolio behavior of member banks during the early 1930's.

CHAPTER IV. EMPIRICAL TESTS OF THE MODEL

This chapter presents empirical findings with regard to the explanatory ability of the model described in Chapter 3 when applied to bank portfolio data for the early depression years. In the first section, we discuss certain aggregation problems which arise because these data are not available on a strictly microeconomic level. Next, the data used in testing are described. The final section outlines the particular testing technique employed, statistical results and estimates of the model's goodness-of-fit.

Aggregation Problems

This theory of bank behavior is specified at a microeconomic level. Hence, to test it properly would require the use of data for individual banks. Unfortunately, such data are not available. The least aggregative data available are for four classes of member banks: Central Reserve City banks in New York City and Chicago, Reserve City banks, and Country banks. Data for non-member banks were not available with the completeness or the frequency necessary for testing.

Use of these rather broad groupings of banks in empirical tests results in some unavoidable aggregation problems. Within each class, there will be differences in individual bank responses resulting from changes in exogenously determined variables such as expected profit rates, D_P, and excess reserves. These responses will vary depending on differences in bank location, competitive position, size, type of customer and other factors unique to each bank.

Furthermore, the aggregate change in the exogenous variables may not

adequately reflect the change in an individual bank's situation:

1. The relevant expected profit rates on particular assets will differ among banks within each Federal Reserve classification. Loan rates, for example, will not be homogeneous for all banks within the group. Even greater variation among banks would be likely for the expected yields on long-term assets -- these will vary according to individual bank prospects for the future.
2. The distribution of exogenously determined assets and liabilities will differ among banks. The deposit mix between time and demand deposits, the proportion of assets set aside as excess reserves and vault cash, and portfolio allocation among those interest-bearing assets which are held constant in the model will not be homogeneous for all banks within a class.
3. The levels of α and β, the minimum acceptable levels of liquidity and soundness, will undoubtedly vary from bank to bank. They will depend on the bank's expectations of future needs and its degree of risk-aversion. One other problem with regard to β may be mentioned here. In assuming that the minimum acceptable level for the ratio of capital to risk-assets is the ratio actually attained, we are implicitly assuming that all banks are sound. The data include banks which were failing, however, whose desired risk ratios were obviously higher than the ratios they actually achieved. To the extent that such banks were included, the employment of the actual risk-asset ratio as the measure of β, the desired ratio, underestimates the latter's true value, and may result in prediction of larger asset portfolios than were consid-

ered optimal. On the other hand, there were no doubt certain banks at any point of time whose risk-asset ratios had attained higher than desirable levels and who were in the process of adjusting them downward. If these two opposing forces were of approximately the same magnitude, the predicted level of β will approach its appropriate value.

Although each class of banks is far from homogeneous, we expect bank situations and responses to be more alike within than among classifications. The degree of homogeneity should be greater for banks in New York City and Chicago than for the broader groupings of Reserve City and Country banks. Banks within each Central Reserve City classification face the same discount rate, are contained within a relatively small geographic area and hence face similar local conditions, and are few in number relative to Reserve City and Country banks. We would therefore expect better predictions from the model for New York and Chicago banks than for the other two groups.

The Data

It seems likely that the banker makes decisions concerning his investment portfolio and borrowings at t on the basis of a rather short horizon. Assuming long horizons in an industry as volatile as banking, and particularly as volatile as banking during the 1930's, does not seem very realistic. Hence, we have assumed the shortest time horizon possible consistent with the data available. The sources for the majority of the data used in empirical tests were Banking and Monetary Statistics (9) and

various issues of the Federal Reserve Board's Annual Reports (48) and monthly Bulletins (49).

In most cases, the data for yields and security prices were available as averages for the month. Linear interpolation was used to convert such data into estimates for the quarterly call dates, which were generally end-of-month dates. Each annual rate was then divided by four to put it on a quarterly basis.

The prevailing rates on prime bankers' acceptances and on stock exchange time loans, each with 90-day maturities, were employed as estimated of $E[r_A]$ and $E[r_S]$, respectively. For Treasury bills, we used the average yield on issues sold by the Treasury within the month. Treasury bills were first issued in December, 1929, and it was not until 1931 that monthly yields were available on a regular basis. Therefore, until 1931, the average yield on three- to six-month Treasury notes and certificates was used as a substitute for the profit rate on Treasury bills. For the classifications of New York City banks, Reserve City banks and Country banks, the discount rate at the Federal Reserve Bank of New York served as a measure of the cost of borrowing. For Chicago banks, however, the discount rate at the Reserve Bank of that city was employed. A published series of weighted average rates charged on customer's loans in principal cities provided the basis for $E\ r_{D_L}$. Prime commercial loans and loans to customers were included in computing the average. The average rate for New York City was given. As a proxy for the Chicago rate, we used the weighted average for eight northern and eastern cities, the largest of which was Chicago. The national average, which was composed of weighted

averages for New York City, the eight northern and eastern cities, and twenty-seven southern and western cities, was employed as the loan rate for Reserve City and Country banks.

As mentioned in Chapter III, the expected profit rate on investments with maturities greater than three months must take into account the expected capital gain. We assume that at t, the price expected for any given security at t+1 is a weighted average of current and past prices, with the weights attached declining as variables recede into the more distant past. We have no way of estimating these weights, but a convenient a priori assumption is that the weights found by Friedman (17, p. 147) in developing his measure of permanent income are also applicable here. Hence, the price expected for any security at t+1 = $.33p_t + .221p_{t-1} \ldots + .001\ p_{t-16}$, where p denotes price, and t, the current period.

The market price of a security is a function of, among other things, its coupon rate and its term to maturity. The series of prices from which the expected price is computed must therefore be based on securities of equal maturity and coupon rate. Similarly, the current price with which this expected price is compared to obtain the expected capital gain must bear the same coupon and maturity date as was used in calculating the expected prices. This amounts to assuming that, of the securities which a banker holds, all those of a given type are equivalent with respect to maturity, coupon and other features. Table 1 presents the features -- coupon rates, term to maturity, and others -- which were used in estimating market prices for the various types of securities in the model.

Table 1. Hypothetical characteristics of securities

Type of security	Coupon rate (%)	Maturity	Other features
Municipal bonds	4	20 years	
U. S. Treasury bonds (until 1931)	4	16 years	Tax exempt
U. S. Treasury bonds (1931-1935)	2 3/4	16 years	
Railroad bonds	5	20 years	
Commercial paper, 4-6 month	4	3 months	
U. S. Treasury notes	3	3 1/2 years	Tax exempt
Utility bonds	5	20 years	

The expected rate of return $E[r]$ between t and t+1 for any one of these securities becomes:

(4.1) $$E[r] = r/4 + (E[p_{t+1}] - p_t)\ .01$$

where:

r = coupon rate on the security

$E[p_{t+1}]$ = expected price at t+1

p_t = price of security at t

The expected capital gain, $(E[p_{t+1}] - p_t)$, is multiplied by .01 in order to put it on a percentage basis.

Banking and Monetary Statistics (9) was the source for data on member bank assets and liabilities on the call dates. In some cases, the use made of this data requires a bit of explanation. The value of acceptances

includes total volume of acceptances payable in the U. S. and abroad held by the particular class of member banks. Loans to brokers and dealers, S, is composed of such loans made to brokers and dealers both inside and outside New York City. D_L, the value of loans to customers, was calculated by subtracting the sum of acceptances, commercial paper, and loans to brokers and dealers held by member banks from total loans. The subtracted items are considered to be a measure of open market loans, acquired at the initiative of the bank rather than in response to loan demand by customers. Treasury bills, U_B, include certificates of indebtedness held by member banks through October, 1934. No such certificates were outstanding for the remainder of the period.

Borrowings for each of the classes of member banks are given in Banking and Monetary Statistics (9). However, these figures include borrowings from those other than Reserve Banks. Borrowings from Reserve Banks, by class of member bank, are available for most of the relevant call dates in various issues of the Federal Reserve Bulletin (49). For those dates where only total member bank borrowings, or only a partial breakdown of such borrowings, at Reserve Banks are given, the share of the undistributed portion accounted for by each class of bank was approximated. This was done by multiplying the percent of total borrowings (from Reserve Banks and others) accounted for by each class on the call date by the total member bank borrowings from the Reserve Banks.

Testing Procedure and Empirical Results

The model developed in Chapter III consists of a linear function to be maximized subject to three linear constraints, two of which are inequal-

ities. As such, it was well suited to testing by linear programming techniques. The availability of the IBM linear programming package, MPS/360 LP, facilitated this testing.

Initially, we employed the model to explain bank holdings of all 11 variables specified in Equation 3.1 for the period 1928 to 1935. The results were not satisfactory since the optimal values of several variables were predicted to be zero. This outcome was probably due to the model's inability to differentiate between assets such as Treasury notes and Treasury bonds, except on the basis of the assumed expected profit rate. However, the banker no doubt does differentiate between these assets, as well as between different types of privately-issued bonds. He may operate under certain rules-of-thumb, such as no more than X percent of the portfolio should be placed in governments, and no more than Y percent in railroad or utility bonds. The model we have developed is, in other words, an ad hoc theory of bank portfolio behavior, not intended to be a definitive statement of the subject.

There are only three variables which the model must explain for it to be of use in predicting free gold and the money supply effects due to the hypothetical security purchase. These variables are acceptances, loans, and borrowings from Reserve Banks. We, therefore, constrained all variables except these three to their actual values on each particular call date. The results were greatly improved, with one exception. For quarters where actual borrowings exhibited severe fluctuations, the fluctuations in the predicted values were excessively large, although they moved in the correct direction. For example, when actual borrowings dropped by 50 percent, predicted borrowings might decrease by 100 percent.

Profitable or not, changes as radical as some of those predicted would probably have been very difficult to accomplish within one three-month period. We therefore constrained the value of borrowings to fall within a maximum and minimum value for each quarter such that:

(4.2) $B \leq B_{t-1} + (q+.1)\ B_{t-1}$

and

(4.3) $B \leq B_{t-1} - (q+.1)\ B_{t-1}$

where:

q = the actual percentage change in borrowings between t-1 and t

Since, in almost all cases of poor prediction, the predicted change moved in the same direction as the actual change, but by too large an amount, the result of imposing these two constraints was to improve the prediction.

The revised model becomes:

Maximize:

(3.1) $E(\pi) = E[r_A]\ A + E[r_{u_B}]\ U_B + E[r_s]\ S + E[r_{u_G}]\ U_G + E[r_{u_N}]\ U_N +$
$E[r_M]\ M + E[r_R]\ R + E[r_U]\ U + E[r_P]\ P + E[r_{D_L}]\ D_L +$
$E[r_B]\ B$

subject to:

(3.8) $A + S + U_B + P - B - \alpha v D_L \geq \alpha(vDp + sTD) - E - V$

(3.10) $A + S + M + R + U + P + D_L \leq K/\beta - O_1$

(3.16) $A + S + U_B + U_G + U_N + M + R + U + P - B = vDp + sTD - O_2 - E$

(4.2) $B \leq B_{t-1} + (q+.1)\ B_{t-1}$

(4.3) $B \geq B_{t-1} - (q+.1)\ B_{t-1}$

(4.4) $U_B = U_{B_t}$

(4.5) $S = S_t$

(4.6) $U_G = U_{G_t}$

(4.7) $U_N = U_{N_t}$

(4.8) $M = M_t$

(4.9) $R = R_t$

(4.10) $U = U_t$

(4.11) $P = P_t$

where $U_{B_t}, \ldots, P_t$ are the actual values of $U_B, \ldots, P$, at time t.

Beginning with 1928 III, the first quarter for which complete data on member bank portfolios are provided, this revised model was tested quarterly through 1935 IV. Not surprisingly, the model predicted poorly until the first quarter of 1930. Abberrations in bank behavior would have been expected during the latter stages of the speculative boom and the subsequent stock market crash. Predicted and actual values of acceptances, loans, and borrowings for each of the four classes of banks over the period 1930 I to 1935 IV are given in Tables 2 through 5. Table 6 contains the data presented in the four preceding tables summed over the four classes of banks; hence, it compares the predicted with the actual values of the variables for all member banks.

Simple comparisons of actual and predicted values of acceptances, borrowings, and loans are not particularly revealing as to the explanatory ability of the model. To provide a better measure of the model's explanatory powers, a chi-square test of goodness-of-fit was employed. However, in order to perform the usual test, which assumes a central chi-square distribution, the sum of the predicted values must equal the sum of the observed values. If this requirement is not met, the distribution is

Table 2. Central Reserve City banks in New York City: Comparison of predicted and actual values for acceptances, borrowings and loans (figures are in millions of dollars)

Date		Acceptances			Borrowings from Reserve Banks			Loans to customers		
Year	Quarter	Predicted	Actual	Actual-predicted	Predicted	Actual	Actual-predicted	Predicted	Actual	Actual-predicted
1930	I	126	129	3	2	3	1	4,480	4,477	-3
	II	164	173	9	35	43	8	4,444	4,437	-7
	III	170	176	6	3	7	4	4,364	4,361	-3
	IV	204	210	6	15	20	5	4,522	4,518	-4
1931	I	249	250	1	7	9	2	4,030	4,038	8
	II	340	340	0	4	5	1	3,851	3,862	11
	III	235	234	-1	14	13	-1	3,978	3,983	5
	IV	199	201	2	40	42	2	3,908	3,904	-4
1932	I	307	311	4	18	22	4	3,413	3,410	-3
	II	419	421	2	0	2	2	2,914	2,915	1
	III	449	449	0	0	0	0	2,685	2,687	2
	IV	482	493	11	0	10	10	2,639	2,628	-11
1933	I	418	424	6	0	5	5	2,458	2,465	7
	II	354	354	0	0	0	0	2,302	2,302	0
	III	420	420	0	0	0	0	2,352	2,352	0
	IV	318	317	-1	0	0	0	2,363	2,366	3
1934	I	455	455	0	0	0	0	2,217	2,216	-1
	II	379	379	0	0	0	0	2,072	2,071	-1
	III	404	403	-1	0	0	0	2,147	2,151	4
	IV	390	390	0	0	0	0	2,047	2,047	0
1935	I	368	367	-1	0	0	0	2,046	2,050	4
	II	272	272	0	0	0	0	2,054	2,054	0
	III	249	248	-1	0	1	1	2,055	2,060	5
	IV	282	281	-1	0	0	0	2,066	2,070	4
Total		7,653	7,697	44	138	182	44	71,407	71,424	17

Table 3. Central Reserve City banks in Chicago: Comparison of predicted and actual values for acceptances, borrowings and loans (figures are in millions of dollars)

Date		Acceptances			Borrowings from Reserve Banks			Loans to customers		
Year	Quarter	Predicted	Actual	Actual-predicted	Predicted	Actual	Actual-predicted	Actual	Predicted	Actual-predicted
1930	I	14	14	0	0	0	0	1,026	1,025	-1
	II	21	21	0	0	0	0	1,078	1,078	0
	III	20	20	0	0	0	0	990	990	0
	IV	30	32	2	0	0	0	1,043	1,044	1
1931	I	37	39	2	0	2	2	931	933	2
	II	45	45	0	0	0	0	940	940	0
	III	25	25	0	0	0	0	894	892	-2
	IV	23	23	0	0	0	0	879	879	0
1932	I	23	24	1	0	3	3	811	819	8
	II	18	25	7	0	6	6	744	746	2
	III	41	41	0	3	4	1	606	607	1
	IV	51	50	-1	0	0	0	503	504	1
1933	I	53	54	1	0	0	0	524	525	1
	II	58	58	0	0	0	0	546	546	0
	III	60	60	0	0	0	0	554	555	1
	IV	55	55	0	0	0	0	482	482	0
1934	I	52	52	0	0	0	0	467	467	0
	II	36	35	-1	0	0	0	441	443	2
	III	46	45	-1	0	0	0	442	443	1
	IV	51	50	-1	0	0	0	399	410	11
1935	I	29	29	0	0	0	0	428	429	1
	II	18	17	-1	0	0	0	418	420	2
	III	14	15	1	0	0	0	395	402	7
	IV	15	16	1	0	0	0	419	419	0
Total		835	845	10	3	15	12	15,960	15,998	38

Table 4. Reserve City member banks: Comparison of predicted and actual values for acceptances, borrowings and loans (figures are in millions of dollars)

Date		Acceptances			Borrowings from Reserve Banks			Loans to customers		
Year	Quarter	Predicted	Actual	Actual-predicted	Predicted	Actual	Actual-predicted	Predicted	Actual	Actual-predicted
1930	I	59	79	20	9	33	24	7,597	7,635	38
	II	37	36	-1	41	42	1	7,542	7,568	26
	III	63	64	1	23	27	4	7,337	7,372	35
	IV	116	119	3	58	63	5	7,607	7,631	24
1931	I	162	167	5	23	29	6	7,317	7,323	6
	II	110	113	3	9	12	3	7,068	7,065	-3
	III	80	77	-3	118	117	-1	6,853	6,871	18
	IV	42	68	26	231	257	26	6,573	6,565	-8
1932	I	48	71	23	159	185	26	6,158	6,172	14
	II	53	73	20	95	113	18	5,793	5,781	-12
	III	77	86	9	65	76	11	5,541	5,561	20
	IV	84	82	-2	47	53	6	5,313	5,317	4
1933	I	108	85	-23	26	31	5	4,536	4,783	247
	II	85	88	3	5	8	3	4,251	4,248	-3
	III	93	99	6	4	11	7	4,269	4,284	15
	IV	93	93	0	7	8	1	4,216	4,232	16
1934	I	101	102	1	3	4	1	4,105	4,104	-1
	II	68	68	0	0	0	0	3,998	3,997	-1
	III	75	74	-1	0	0	0	4,005	4,006	1
	IV	183	71	-112	0	0	0	3,826	3,938	112
1935	I	70	69	-1	0	1	1	3,869	3,890	21
	II	57	57	0	0	0	0	3,884	3,884	0
	III	70	69	1	0	0	0	3,987	3,997	10
	IV	77	75	-2	0	0	0	4,025	4,035	10
Total		2,011	1,985	-26	923	1,070	147	129,670	130,259	589

Table 5. Country member banks: Comparison of predicted and actual values for acceptances, borrowings and loans (figures are in millions of dollars)

Date		Acceptances			Borrowings from Reserve Banks			Loans to customers		
Year	Quarter	Predicted	Actual	Actual-predicted	Predicted	Actual	Actual-predicted	Predicted	Actual	Actual-predicted
1930	I	6	31	25	146	171	25	8,181	8,179	-2
	II	0	12	12	174	189	15	8,164	8,200	36
	III	0	8	8	130	138	8	7,979	7,979	0
	IV	0	8	8	156	164	8	7,773	7,765	-8
1931	I	0	7	7	116	126	10	7,474	7,519	45
	II	0	4	4	126	130	4	7,329	7,331	2
	III	21	3	-18	206	193	-13	6,972	7,040	68
	IV	0	10	10	315	324	9	6,512	6,506	-6
1932	I	0	14	14	358	322	-36	6,221	6,216	-5
	II	0	18	18	302	319	17	5,940	5,927	-13
	III	0	14	14	237	251	14	5,682	5,691	9
	IV	0	5	5	166	172	6	5,430	5,437	7
1933	I	0	7	7	118	132	14	4,694	4,826	132
	II	0	8	8	80	91	11	4,174	4,215	41
	III	0	7	7	66	73	7	4,200	4,193	-7
	IV	2	9	7	60	67	7	4,140	4,143	3
1934	I	10	17	7	28	35	7	4,122	4,117	-5
	II	6	10	4	16	19	3	4,032	4,031	-1
	III	10	13	3	8	10	2	3,937	3,934	-3
	IV	7	9	2	6	7	1	3,860	3,860	0
1935	I	9	10	1	4	5	1	3,791	3,792	1
	II	4	7	3	4	6	2	3,801	3,805	4
	III	8	8	0	4	5	1	3,742	3,763	21
	IV	8	7	-1	4	4	0	3,740	3,756	16
Total		91	246	155	2,830	2,953	123	131,890	132,225	335

Table 6. All member banks: Comparison of predicted and actual values for acceptances, borrowings and loans (figures are in millions of dollars)

Date		Acceptances			Borrowings from Reserve Banks			Loans to customers		
Year	Quarter	Predicted	Actual	Actual-predicted	Predicted	Actual	Actual-predicted	Predicted	Actual	Actual-predicted
1930	I	205	253	48	157	207	50	21,284	21,316	32
	II	213	242	29	250	274	24	21,228	21,282	54
	III	253	268	15	156	172	16	20,670	20,702	32
	IV	350	369	19	229	247	18	20,945	20,958	13
1931	I	448	463	15	146	166	20	19,752	19,813	61
	II	495	502	7	139	147	8	19,188	19,197	9
	III	361	339	22	338	323	-15	18,697	18,786	89
	IV	264	302	38	586	623	37	17,872	17,854	-18
1932	I	378	420	42	535	532	-3	16,603	16,617	14
	II	490	537	47	397	440	43	15,391	15,369	-22
	III	567	590	23	305	331	26	14,514	14,546	32
	IV	617	630	13	213	235	22	13,885	13,886	1
1933	I	579	570	-9	144	168	24	12,212	12,599	387
	II	497	508	11	85	107	22	11,273	11,311	38
	III	573	586	13	70	84	14	11,375	11,384	9
	IV	468	474	6	67	75	8	11,201	11,223	22
1934	I	618	616	-2	31	39	8	10,911	10,904	-7
	II	489	492	3	16	19	3	10,543	10,542	-1
	III	535	535	0	8	10	2	10,531	10,534	3
	IV	631	520	-111	6	7	1	10,132	10,255	123
1935	I	476	475	-1	4	6	2	10,134	10,161	27
	II	351	353	2	4	6	2	10,157	10,163	6
	III	342	340	-2	4	6	2	10,179	10,222	43
	IV	382	379	3	4	4	0	10,250	10,280	30
Total		10,582	10,763	181	3,894	4,228	334	348,927	349,904	977

non-central (33). Because the sums of predicted and actual values in our tests differed, it was necessary to make an adjustment for non-centrality before applying the central chi-square test.

A central chi-square has a mean of f and a variance of 2f, where f is the degrees of freedom. The non-central chi-square has a mean of $f+L_o$ and variance of $2(f+2L_o)$ where L_o is called the non-centrality parameter. The most theoretically satisfactory method of estimating the degree of noncentrality is to estimate both the parameters f and L_o simultaneously by using, for example, maximum likelihood methods. However, this leads to very complicated nonlinear equations. Therefore, we have employed a second method suggested by Professor J. K. Sengupta,[1] which seeks to adjust for the effects of noncentrality in order to derive a revised estimate of the parameter f. This method has been employed by Professor Sengupta in some of his studies (41) on stochastic programming. The technique consists of defining an adjustment factor such that:

$$\lambda = \frac{|\Sigma O_i - \Sigma E_i|}{n} \tag{4.12}$$

where:

O_i = i^{th} observed value

E_i = i^{th} predicted value

n = number of observations

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[1] Sengupta, J. K. Iowa State University, Ames, Iowa. Non-central chi-square distribution. Private communication. 1969.

The value of f is then adjusted for noncentrality by adding to it the value of 2 λ. After this modification, the usual central chi-square test may be applied. This method, it should be emphasized, is only approximate, but it has the merit of being simple and operational.

For each of the three variables -- acceptances, loans and borrowings -- the hypothesis that the model predicts the actual value of the variable is tested. This hypothesis is rejected at a particular level of significance when the calculated chi-square exceeds the tabulated value at that level. In this case, the calculated chi-square is said to be significant. The better the fit of the model, the fewer will be the significant chi-squares obtained. In most of the tests, a .95 level of significance was employed. A summary of the significance tests is provided in Table 7, and a description of the results is contained in the following paragraphs.

As we expected, the model did a better job of predicting A, D_L and B for New York City and for Chicago banks than for the other two classes. Furthermore, it explained the behavior of country banks better than that of banks under the Reserve City classification. For New York City and Chicago banks, the chi-square values for A and D_L are not significant at the .95 level, if even without adjustment for noncentrality. Hence, at this level of significance, we do not reject the hypothesis that our model explains bank holdings of these two assets during the period 1930-1935.

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[1] If we were adjusting the variance of a central chi-square for the effect of non-centrality using this approximation, the estimated variance would become $2(f+2\lambda)$. Since the mean of a central chi-square is half its variance, f is adjusted by 2λ rather than λ.

Table 7. The results of chi-square goodness-of-fit tests

Class of bank	Variables for which the chi-square was not significant at a level of: .95	.975	.99	.995
New York City	A			
	D_L			B
Chicago	A			
	D_L			
Reserve City			A[a]	
	D_L			
	B[b]			
Country	D_L			
	B			
All Member banks		A		
	D_L			
	B			

[a]Omitting 1934 IV.

[b]Omitting 1930 I.

The application of the goodness-of-fit test to borrowings for the two Central Reserve City classes was not entirely appropriate because a zero (less than $500 thousand) level of borrowings was predicted for a number of quarters. A chi-square test for New York City banks was performed by combining quarters 1932 I through 1935 IV into one class, thus reducing the degrees of freedom by 15. The calculated chi-square was not

significant at the .995 level, although it exceeded the tabulated value at a .95 level. As an alternative test, the average absolute percentage deviation of predicted from actual borrowings was computed, which yielded a value of 25 percent. This test seems no more adequate than the chi-square, since due to the very small values of both predicted and actual B, any deviation appears as a rather sizeable percent. It can be seen by inspection that the errors in prediction in absolute terms were quite small. For Chicago banks, the difficulty was even greater. In order to perform a chi-square test, it is generally recommended that if the predicted value for any one class is no greater than 3, that class should be combined with another. However, for Chicago banks, the sum of predicted borrowings for all quarters was only 3. It was clearly impossible to use the goodness-of-fit test, but the model predicted the borrowings by Chicago banks reasonably well. For 20 of 24 quarters, the actual level of borrowings was zero, and this was the value predicted by the model for each of those quarters.

The calculated chi-square for acceptances held by Reserve City banks was well above the tabulated value at a .95 significance level. However, the difference is primarily due to the predictive error in one quarter -- 1934 IV. This quarter contributed more than half the total of the calculated chi-square. Eliminating this period, the chi-square value is no longer significant at a .99 level, although it still exceeds the tabled value for a .95 level of significance.

As for New York City and Chicago banks, several quarters of predicted borrowings by Reserve City banks had to be combined before testing for

goodness-of-fit. The predicted values for 1934 I through 1935 IV were, with one exception, all zero. A sizeable prediction error in 1930 I produced a rather large chi-square value. For that quarter, predicted borrowing was well below actual. Perhaps this was due to a greater than normal desire for liquidity on the part of Reserve City banks as a result of the recent stock market crash. Omitting this quarter, the chi-square value for borrowings is no longer significant at a .95 level. Loans to customers were well-predicted for Reserve City banks, as they were for the Central Reserve City banks. Even without adjustment for noncentrality, the calculated chi-square was not significant at the level of .95.

Again using .95 as the level of significance, we can assert that the model performed well in predicting Country bank borrowings and loans. Without adjustment for the effect of noncentrality, neither variable had a significant chi-square value. However, the chi-square test revealed a much poorer fit for acceptances held than for the other two Country bank variables. The calculated chi-square was significant at all levels. One reason for this was that the necessity of combining the large number of classes for which zero acceptance holdings were predicted greatly reduced the degrees of freedom and hence the tabulated chi-square value. This is not the entire explanation, however. Although Country banks held relatively few acceptances during this period, the model estimates even smaller optimal holdings in almost every quarter. One possible reason for this might be that the relevant acceptance rate for Country banks was greater than the open market rate in New York City, which was the rate employed in tests.

Chi-square tests were also performed on the combined results for all member banks. The calculated chi-squares for loans and borrowings of all member banks were not significant at the .95 level. In fact, as had been true for each class individually, the chi-square for loans did not show significance even when no adjustment for noncentrality was performed. Moreover, broadening the period to include 1928 III to 1929 IV did not affect these results for loans. Due to the errors in prediction for Reserve City and Country banks, the chi-square value for acceptances held by all member banks was significant at the .95 level, although the significance disappeared at a .975 level.

The model developed in Chapter III, with the slight modifications described in this chapter, appears to do an adequate job of explaining member bank acceptance holdings, loans and borrowings from Reserve Banks during the period 1930-1935. As anticipated, its best performance was for the least aggregative groups of banks -- Central Reserve City banks in New York City and Chicago. It seems likely that the poorer explanatory ability for Reserve City and Country banks is at least partially due to the aggregation problems discussed in the first section of this chapter. For every class of bank, the model performed best in explaining the largest of the three variables -- customer loans.

In the following chapter we will employ the model to predict bank behavior under hypothetical circumstances rather than to explain actual behavior, as was done in this chapter. There we will alter certain of the exogenous variables under the assumption of a hypothetical $1 billion open market purchase, and will predict the resulting optimal values of A, D_L and B.

CHAPTER V. FREE GOLD, THE MONEY SUPPLY AND ALTERNATIVES TO FEDERAL RESERVE POLICY

Professors Friedman and Schwartz have suggested that a more forceful Federal Reserve policy in late 1931 -- namely, the purchase of $1 billion in government securities -- could have been of great assistance in slowing the rapid deterioration of economic conditions. Such a policy would, by their calculations, have stabilized the money stock, and could have been pursued without endangering the free gold position of the Reserve Banks. With the aid of the model developed in Chapter III and tested in Chapter IV, we will now subject these assertions to a test. We will attempt to determine what quantitative effect an open market operation of this size would have had on the money supply and on free gold.

A secondary purpose of this chapter will be to investigate the propitiousness of three alternatives which Friedman and Schwartz claim could have been pursued by the System to relieve the free gold problem -- had free gold been regarded as a problem. The potential effect on free gold of a reduction in Reserve Bank till money to a minimum -- the quantitative effects of which were estimated in Chapter II -- will be discussed briefly here. Secondly, Friedman and Schwartz assert that the Reserve Banks could have purchased bills rather than governments had the level of free gold been considered an insurmountable obstacle to open market operations. A third and untouched possibility was to encourage member bank borrowing. In the concluding section of this chapter are presented a few observations on the more qualitative aspects of the Friedman-Schwartz argument which are contained in Points 1, 2, 3 and 5 on pages 8 and 9.

Preliminary Assumptions

Suppose that from August through December, 1931 the Reserve Banks had engaged in a large open market purchase program, resulting at the end of the year in System holdings $1 billion larger than were actual holdings on that date. Given a constant volume of U. S. Government debt outstanding, these securities would have been obtained partly from member banks and partly from non-member banks and other holders of the debt. The model contains, as constrained variables, the amount of U. S. Government bills, notes and bonds held by each class of member bank. The values of these variables will change as securities are sold to the System by member banks, and a procedure is needed for estimating the volume of such sales. We first calculate the amount of governments available to the private sector, and this quantity is termed G_X.

(5.1) $$G_X = G_O - G_G - G_S$$

where:

G_O = total U. S. Government debt outstanding

G_G = U. S. Government securities held by federal agencies and trust funds

G_S = U. S. Government securities held by Federal Reserve Banks

The percent of G_X accounted for by each of the four classes of member banks on two dates: December 31, 1931, and June 30, 1932 was then computed. These percentages are presented in Table 8.

We will consider two alternative assumptions as to the effect of the security purchase on member bank portfolios of governments: (1) The percentage of G_X held by each group of banks is unchanged by the purchase; hence, the first row of Table 8 becomes relevant; (2) the percentage of G_X

Table 8. Percent of G_X held by each class of member bank

Date	Central Reserve City member banks: New York City	Chicago	Reserve City member banks	Country member banks
December 31, 1931	10.9	1.8	11.4	8.8
June 30, 1932	12.0	1.4	11.6	8.5

held by each class of bank is altered by the Federal Reserve purchase by an amount equal to the actual change between December, 1931, and June, 1932, during which time System holdings did rise by approximately $1 billion. For this case we employ the second row of Table 8. These two assumptions will be referred to as Assumption 1 and Assumption 2, respectively, throughout the remainder of this paper.

The purchase program would have reduced G_X by $1 billion. Multiplying each of the percentages in Table 8 by the new value for G_X yields the hypothetical government security holdings of each banking class.

Between December, 1931, and June of the following year, the Reserve Banks increased their holdings of all three types of Treasury securities -- bills, notes and bonds. Of the total change of $967 million, bills accounted for 67.6 percent, notes for 24.5 percent, and bonds for only 8.1 percent. Operating on the premise that the purchase would have been distributed in the same manner had it been completed six months earlier, and assuming that the sales by member banks are distributed in the same manner as Federal Reserve purchases, the hypothetical holdings

of bills, notes and bonds for each group of member banks were calculated. These results are presented in Table 9.

The term G in Table 9 is defined as the total value of government securities held by a particular class of bank. Hence, $G = U_B + U_N + U_G$. The values in the first column under each heading -- New York City, Chicago, etc. -- were derived with the use of Assumption 1. In each case, second column values were estimated under Assumption 2.

Certain of the other exogenous variables in the model should be affected by the System's purchase. These include E, D_p and TD. To the extent that member banks sell governments to the Reserve Banks and retain the proceeds as deposits in those banks rather than lending them, excess reserves will rise. If the non-bank public deposits the proceeds of its security sales in member banks, D_p and/or TD will rise, and ceteris paribus, excess reserves will be augmented by $v \Delta D_p$ and/or $s \Delta TD$. The problem is that the ceteris paribus assumption will not hold. Member banks are sure to employ some of their newly created reserves to acquire interest-earning assets or to repay borrowings. Part of the funds received by the non-bank public from its sales of securities will no doubt be held as currency, or will be deposited in non-member rather than member banks. Some method for predicting the change in D_p, E and TD is needed.

It will be assumed that completion of the purchase program by December 31, 1931, would have produced the same rate of expansion in E and D_p as occurred between that month and June, 1932. Both E and D_p for member banks declined during the period immediately preceding the 1932 operation and rose while the purchase proceeded, as would be expected.

Table 9. Government securities held by member banks: Hypothetical sales (purchases) and hypothetical holdings (figures in millions of dollars)

	New York City banks		Chicago banks		Reserve City banks		Country banks		All member banks	
	Assumption 1[a]	Assumption 2[b]	Assumption 1[a]	Assumption 2[b]	Assumption 1[a]	Assumption 2[b]	Assumption 1[a]	Assumption 2[b]	Assumption 1[a]	Assumption 2[b]
Hypothetical change:										
All government securities (G)	-114	53	-15	-76	-114	-83	-82	-128	-325	-235
Treasury bills (U_B)[c]	-77	36	-10	-51	-77	-56	-55	-87	-219	-158
Treasury notes (U_N)[d]	-28	13	-4	-19	-28	-20	-20	-31	-80	-57
Treasury bonds (U_G)[e]	-9	4	-1	-6	-9	-7	-7	-10	-26	-19
Hypothetical holdings:[f]										
All government securities	1,654	1,821	273	212	1,730	1,761	1,336	1,290	4,993	5,084
Treasury bills (U_B)	131	326	142	101	110	131	0[g]	0[g]	465	558
Treasury notes (U_N)	1,310	172	35	20	82	90	107	64	355	346
Treasury bonds (U_G)	1,654	1,323	97	92	1,539	1,541	1,228	1,225	4,174	4,181

[a] Using December 31, 1931 values for the percent of G_X held.

[b] Using June 30, 1932 values for the percent of G_X held.

[c] $.676 \triangle G$.

[d] $.245 \triangle G$.

[e] $.081 \triangle G$.

[f] Actual values + hypothetical change.

[g] The value of U_B held by Country banks in December, 1931, was only 50. The hypothetical reduction of U_B in excess of this amount was shifted to U_N.

It therefore seems reasonable to conclude that the expansion of E and D_p was largely due to the System's policy, and that an effect of similar magnitude would have resulted from adoption of the policy six months sooner. The path of time deposits differed from that of E and D_p, however. They declined both before and during the 1932 purchase program, and continued to decline until 1933. It appears that the more vigorous policy had little effect in stopping, much less reversing, the downward trend of time deposits. We will therefore assume that a similar policy adopted in 1931 would have had no significant effect on the level of time deposits.

Because little accuracy can be claimed for these estimated changes in E and D_p, a range of + and - 10 percent will be assigned to the predicted values. The maximum potential change in each of these variables is assumed to be the actual change plus 10 percent, and the minimum change to be the actual change less 10 percent. The model was tested with each of these three combinations of E and D_p.

In Chapter II, we discussed the estimates given by Friedman and Schwartz (18) as to the effect of a hypothetical security purchase on the money supply. Their calculations are summarized in Table 10.

The $231 million expansion of currency in circulation which Friedman and Schwartz predict has been accepted as a reasonable estimate. Furthermore, it is postulated as a simplifying assumption that non-member bank deposits, which accounted for 22.24 percent of total deposits in December, 1931, rise by 22.24 percent of the total deposit increase of $4.728 billion which Friedman and Schwartz predict. In order for the money supply to remain stable, member bank deposits must therefore rise by 3.676 billion

Table 10. Money supply effect hypothesized by Friedman and Schwartz (figures are in billions of dollars)

Variable	Hypothetical value (January, 1932)	Actual value (January, 1932)	Hypothetical change
M	41.525	36.566	4.959
C	5.127	4.896	.231
D	36.398	31.670	4.728

dollars. The exogenous variables in the model must be at levels which will make this expansion possible.

The mean value assumed for the rise in D_p for all member banks is $572 million. Since a zero change in time deposits has been assumed, the model must allow for a potential increase in D_L of 3.104 billion dollars.[1] An alteration in the December, 1931 value for the soundness constraint, Equation 3.10,[2] is necessary to allow this possibility. If capital accounts, the risk-asset ratio, and the quantity O_1 are unaffected by the purchase, D_L can rise only to the extent that member banks are holding acceptances. It seems unlikely that the open market purchase would have much effect on capital or on O_1, which is comprised largely of non-interest earning assets. However, if an easy money policy caused bankers to expect fewer bank failures and a better business climate, and to believe that

[1] Since $D = D_L + D_p$.

[2] (3.10) $A + S + M + R + U + P + D_L \leq K/\beta - O_1$.

loans and other investments have become less risky, the result might well be a reduction in the desired risk-asset ratio. In order to allow the possibility of money supply stability as the consequence of an open market purchase, it is assumed that β, the minimum acceptable risk-asset ratio, declines to the extent necessary for potential D_L to expand by \$3.104 billion.

Several calculations are necessary in order to arrive at estimates of the reduced value of β for each class of member bank. We first estimate the necessary rise in total deposits, D, for each class of bank, assuming that deposits for each class rise in proportion to the percent of total member bank deposits accounted for by that class in December, 1931. From this amount is subtracted the mean hypothetical change in D_P for each class. This yields the potential rise in D_L, by class of bank, necessary for stability of the money stock. Since banks can substitute loans for acceptances in their portfolios, D_L has a potential for expansion equal to bank holdings of acceptances without any decline in the risk-asset ratio. The excess of the required potential change in D_L over bank holdings of acceptances is the rise in D_L which must be facilitated through reductions in the risk-asset ratio. The necessary changes in the desired risk-asset ratios of each class of member bank are presented in Table 11.

Table 11. Actual and hypothetical risk-asset ratios for December 31, 1931

Risk-asset ratio	Central Reserve City member banks: New York City	Central Reserve City member banks: Chicago	Reserve City member banks	Country member banks
Actual value	.282	.203	.199	.193
Hypothetical value	.266	.169	.180	.173
Actual-hypothetical	.016	.034	.019	.020

Money Supply Effects of the Hypothetical Open Market Operation

Using the hypothetical values of U_B, U_G, U_N, E, D_P, TD and β derived in the preceding section, the model was re-estimated for December, 1931. Employing in turn, each of Assumptions 1 and 2 to estimate U_B, U_G and U_N in conjunction with each of the three hypothetical values for E and D_P yielded six sets of results for each class of bank. To simplify the reader's task, the assumptions discussed in the preceding section which concern variables in the model are summarized in Table 12. The assumptions regarding D_P and E are identified by numbers, as are those pertaining to U_B, U_G and U_N, which continue to bear numbers 1 and 2. These numbers will be utilized in presenting test results.

In Table 13, the six sets of results obtained for each class of member bank are presented. The values under the heading "All member banks" represent the sum of the values for each separate class. The last three columns of the table show the predicted changes in total member bank A,

Table 12. Assumptions used in predicting free gold and money supply effects

Variable	Assumption
U_B, U_N and U_G	1. The percent of G_X held by each class of bank remains unchanged at its December, 1931 level.
	2. The percent of G_X held by each class of bank acquires its June, 1932 value.
E and D_P	3. Changes by 100 percent of the actual change between December, 1931 and June, 1932.
	4. Changes by 110 percent of the actual change between December, 1931 and June, 1932.
	5. Changes by 90 percent of the actual change between December, 1931 and June, 1932.
TD	No change
β	Declines to the extent necessary to allow an expansion of D_L by \$3.104 billion

D_L and B as a result of the security purchase under each of the assumption sets.

Table 14 contains the estimates used to draw conclusions regarding the effect of the \$1 billion purchase on the money supply. The total hypothetical change in member bank deposits under each of the six assumption sets is presented there. This change is the sum of the change in D_P estimated under Assumption 3, 4 or 5 plus the change in D_L predicted by the model under the corresponding assumed value for D_P. On page 74, we

Table 13. Predicted effects on acceptances, loans and borrowings of a $1 billion open market purchase (figures are in millions of dollars)

Assumptions used[a]	Central Reserve City member banks: New York City Predicted value of:			Chicago Predicted value of:			Country member banks Predicted value of:		
	Acceptances	Loans	Borrowings	Acceptances	Loans	Borrowings	Acceptances	Loans	Borrowings
1 and 3	362	4,248	0	0	355	.11	0	7,490	257
1 and 4	378	4,232	0	0	409	.11	0	7,560	257
1 and 5	347	4,263	0	0	301	.11	0	3,757	43
2 and 3	185	4,325	0	7	768	0	0	7,696	226
2 and 4	201	4,309	0	12	787	0	0	7,696	221
2 and 5	170	4,340	0	2	750	0	0	7,696	230

[a]The numbers used for assumptions correspond to those given in Table 12.

Table 13 (Continued)

Assumptions used	Reserve City member banks Predicted value of:			All member banks Predicted value of:			All member banks Predicted change[b] in:		
	Acceptances	Loans	Borrowings	Acceptances	Loans	Borrowings	Acceptances[c]	Loans	Borrowings[c]
1 and 3	61	7,578	0	423	19,671	257	111	1,817	-366
1 and 4	88	7,551	0	466	19,752	257	164	1,898	-366
1 and 5	35	7,604	0	382	15,925	43	80	-1,929	-580
2 and 3	27	7,612	0	219	20,401	226	-83	2,547	-397
2 and 4	53	7,586	0	266	20,378	221	-36	2,524	-402
2 and 5	11	7,639	0	183	20,425	230	-130	2,571	-393

[b]Hypothetical value less actual value on December 31, 1931.

[c]Compare these predictions for ΔB and ΔA with the assumptions of Friedman and Schwartz. With one exception, the model predicts a lesser decline in B than the $560 million assumed by Friedman and Schwartz. In no case is an increase in $A_F (= -\Delta A)$ predicted which is as large as the $210 million that Friedman and Schwartz assume.

Table 14. Comparison of the predicted change in member bank deposits with the estimated change necessary for money supply stability (figures are in millions of dollars)

	All member banks			
Assumptions:	ΔD_L	ΔD_P	$\Delta D_L + \Delta D_P = \Delta D$	$3.676 billion $- \Delta D$
1 and 3	1,817	572	2,389	1,287
1 and 4	1,898	650	2,548	1,128
1 and 5	-1,929	494	-1,435	5,111
2 and 3	2,547	572	3,119	557
2 and 4	2,524	650	3,174	502
2 and 5	2,571	494	3,065	611

noted that, given the hypothetical increase in currency of $231 million and an expansion of non-member bank deposits by 22.24 percent of the necessary deposit increase, member bank deposits must be inflated by $3.676 billion to produce stability of the money stock. In the last column of Table 14, the predicted increase in member bank deposits is subtracted from $3.676 billion, yielding estimates of the extent to which the money stock would have declined between August, 1931, and December 31, 1931, even with the stimulation produced by an additional $1 billion open market purchase.

As can be seen from Table 14, in no case is the estimated rise in member bank deposits sufficient to arrest the decline in the money stock. This is true even accepting the Friedman-Schwartz estimate of the rise in

currency, and granting rather liberal possibilities for the expansion of non-member bank deposits and the decline in β, the desired risk-asset ratio. The maximum predicted increase in the December, 1931 value of member bank deposits is $3.174 billion which implies a decline in the money stock of $502 million between August and December of that year. The mean prediction is for a deterioration in the money supply of $1,533 million. Should non-member bank deposits have risen at a rate in line with that predicted for member banks, rather than at a much more rapid rate which was assumed, the decline in the money stock between August and December would have been even greater than is indicated in Table 14. And there is no particular reason to expect that an open market operation would have been more stimulating to non-member than to member banks. The conclusion to which this analysis leads is that, contrary to the assertions of Friedman and Schwartz, an open market purchase of $1 billion undertaken during the closing months of 1931 would have been insufficient to halt the decline in the supply of money.

One other observation as to money supply effects seems relevant here. When System holdings of government securities rose by $1 billion between January and July, 1932, the money stock did not cease its downward plunge. The estimates of Friedman and Schwartz (18, p. 713) are that the money stock dropped by approximately $2.5 billion between January and July. This result, according to Friedman and Schwartz (18, p. 347) was largely due to a renewed outflow of gold, mainly to France, during the spring and early summer of 1932; and to a sudden flurry of bank failures in June which produced further declines in the deposit-currency and deposit-

reserve ratios. One factor could have been largely responsible for these offsets to Reserve System policy -- the withdrawal of gold by France, whose short-term balances in the U. S. had all but evaporated by June, 1932. This raid on gold might well have been precipitated by the purchase program itself, if the easy money policy caused France to lose confidence in the ability of the U. S. to remain on the gold standard. The gold outflow no doubt put pressure on individual commercial banks, and may have been responsible for many of the bank failures of June, 1932. Fear generated by bank failures would then have encouraged the public to step up its currency withdrawals, and banks to maintain a larger proportion of their assets as excess reserves -- hence, the declines in the deposit ratios. This one-factor explanation of conditions in 1932 is no doubt an oversimplification: But the point is that a similar sequence of events, beginning with the withdrawal of French balances, might easily have occurred in 1931 had the purchase been undertaken at that time. The effect would have been an even greater decline in the money stock between August and December, 1931, than that which has been predicted.

Effect of the Hypothetical Purchase on Free Gold

The predicted change in free gold is determined by substituting the estimated values for ΔB_F and ΔA_F into Equations 2.26 and 2.27, which are duplicated below:

(2.26) $\Delta G_{F_a} = \$331.34 \text{ million} + .5525(\Delta B_F + \Delta A_F)$

(2.27) $\Delta G_{F_b} = -\$222.34 \text{ million} + .5525(\Delta B_F + \Delta A_F)$

To simplify presentation of the results, it is assumed that borrow-

ings from the Reserve Banks, B_F, are altered by exactly the amount of the change in member bank borrowings, B, and that System holdings of acceptances, A_F, change by the negative of the change in member bank holdings, A. The first assumption implies that non-member bank borrowings are unaffected by the open-market purchase, while the second implies no change in the acceptance holdings of anyone other than member banks and the Reserve System. We will return to these assumptions after discussing their implications for the value of free gold.

Under these assumptions $\Delta B_F + \Delta A_F$ in Equations 2.26 and 2.27 equals $\Delta B - \Delta A$ predicted by the model. We have six hypothetical values for $\Delta B - \Delta A$, corresponding to each of the sets of assumptions regarding governments, excess reserves and D_P held by member banks. There are two possible values, given in 2.26 and 2.27, for the sum of other changes in the free gold equation. There are therefore 12 possibilities for the change in free gold resulting from the security purchase. These are presented in Table 15.

At the end of 1931 free gold was approximately $600 million. The minimum decline in free gold predicted under any set of assumptions is $367.65 million, which would have reduced free gold to only slightly more than $225 million. The mean decrease under the assumption that the minimum necessary value for till money in Reserve Banks was 10 percent of notes in circulation (Equation 2.26) is $571.68 million. Such a reduction in December, 1931 would have reduced free gold to an almost non-existent level. If vault cash could have dropped to 6 percent of Reserve note circulation (Equation 2.27), a mean decline of $462.68 million in free

Table 15. Predicted effects of a hypothetical security purchase on free gold (figures are in millions of dollars)

Assumption	$\Delta B - \Delta A = (\Delta B_F + \Delta A_F)$	.5525 $(\Delta B - \Delta A)$	Equation 2.26 (ΔG_{F_a})	Equation 2.27 (ΔG_{F_b})
1 and 3	-314	-173.48	-504.82	-395.82
1 and 4	-366	-202.22	-533.56	-424.56
1 and 5	-263	-145.31	-476.65	-367.65
2 and 3	-477	-263.54	-594.88	-485.88
2 and 4	-530	-292.83	-623.17	-515.17
2 and 5	-660	-364.65	-695.99	-586.99
Average	-435	-240.34	-571.68	-462.68

gold is predicted. Free gold would consequently have fallen to approximately $135 million -- a level lower than had ever been known.

If non-member bank borrowings were reduced as a result of the System's purchase, which would be a likely consequence, the decline in free gold under each assumption is correspondingly greater. Under some assumptions, the model predicts a decrease in A. If these acceptances are sold to those other than Reserve Banks, A_F will not rise as assumed, and free gold will be depleted more than is indicated. Moreover, if some reduction in the gold stock, such as occurred during the first six months of 1932 when the French withdrew short-term balances of $500 million, were to result from open market operations in 1931, the free gold position

would deteriorate further. The evidence indicates that an open market purchase of $1 billion carried out between August and December, 1931, would have very likely eliminated free gold completely. Free gold was not adequate to bear the additional strain.

A closely related potential effect of open market purchases in late 1931 was the possibility of a shortage in reserves against deposits. As mentioned in Chapter 1, it was this contingency rather than a shortage of free gold over which Goldenweiser (20) expressed anxiety. The excess or deficiency of reserves available against deposits can be defined as:

$$(5.2) \qquad E_D = R - G_P - .35D$$

where:

G_P = total gold pledged exclusively against Federal Reserve notes = gold in the redemption fund and with Federal Reserve Agents

E_D = excess of reserves available against deposits

If gold in the redemption fund and with Federal Reserve Agents were precisely equal to gold required for these purposes, there would be no difference between free gold and E_D. In practice, however, the gold held against notes was always in excess of the amount required in order to minimize the nuisance of having to make frequent deposits and withdrawals with Reserve Agents and the redemption fund. Furthermore, the Reserve Banks were particularly strongly committed to preventing any deficiency from occurring in the reserve against notes, for such a deficiency legally obligated the Reserve Banks to increase the discount rate and to pay a progressive tax on the deficiency to the Federal Government. If the Reserve Banks continued to maintain a cushion for gold pledged against

notes, and large open market operations had been carried out in 1931, a deficiency in the reserve against deposits would have resulted well before free gold were eliminated.

Alternative Policies

The reduction of counter cash

It is improbable that the Reserve Banks could have reduced till money to less than 6 percent of Federal Reserve notes in circulation in December, 1931. This was the value assumed in estimating Equation 2.27. The Board's statement of February, 1932, implied that 6 percent was the minimum ratio required "as an operating matter." (48, 1932, p. 18) Since seasonal currency demands would have been greater in December than in February, the minimum necessary ratio should certainly have been no lower in December. Therefore, I believe the estimates given under ΔG_{F_b} in Table 15 take into account the extent to which the reduction of vault cash could have alleviated the free gold problem. If 6 percent were indeed the minimum ratio needed, however, it is true that the Reserve Banks did not exploit this alternative to the full, for till money was never less than 10 percent of Reserve note circulation during the months immediately preceding the passage of the Glass-Steagall Act.

The encouragement of member bank borrowing

If the System had regarded free gold as a serious barrier to open market operations, Friedman and Schwartz contend, it could have encouraged member bank borrowing. Borrowing, by adding to Reserve Bank holdings of eligible paper, would have increased the value of free gold. Presumably, Friedman and Schwartz are suggesting the use of this policy in conjunction with open market operations, for it is clear that a policy of encouraging

borrowings would, by itself, have done very little to improve economic conditions.

These authors state (18, p. 395) that the Reserve Banks paid only "lip service" to the lend-freely dictum which was an essential component of Bagehot's prescription for dealing with the twin evils of internal and external crises. In rebuttal to Friedman and Schwartz, we note that by early 1931, System officials were recommending a change in the Federal Reserve Act to allow member banks to borrow more easily. It was suggested that borrowing be allowed on member banks' own promissory notes secured by non-eligible collateral. Changes similar to those recommended were later embodied in the Glass-Steagall Act. It appears, then, that Reserve officials were concerned with facilitating member bank borrowing. After the onset of the financial crisis in 1931, the Reserve Banks agreed to " ... pursue a liberal policy toward member banks in difficulty; such banks should be encouraged to borrow freely from the Reserve Banks ...." (6, p. 69) Goldenweiser (20, p. 160) describes the use of this policy:

> " ... at many Federal Reserve Banks the management went as far as the law permitted and interpreted it rather liberally in efforts to help out member banks known to be fundamentally solvent but in difficulties owing to the drop in prices and the loss of public confidence in the banks. Much work of this sort was done by the Reserve Banks for banks which were scraping the bottom of the barrel for acceptable assets on which to borrow from the Federal Reserve. There is in many districts a warm friendship for the Federal Reserve for the timely and generous help received during that trying time."

It might be argued that statements such as these reveal a Federal Reserve policy of encouraging borrowing by individual banks facing bank runs and similar difficulties, but not necessarily a general policy of boosting borrowing in the aggregate. Friedman and Schwartz suggest that

the use of direct pressure (which had been unsuccessfully employed in 1929 to discourage borrowing) in reverse could have been used to stimulate total bank borrowings. I cannot agree. Federal Reserve pronouncements encouraging bank appearances at the discount window would have influenced banks little at a time when there was a dearth of suitable loan customers and the business outlook was bleak.

Borrowing could also have been increased, Friedman and Schwartz maintain, by having made it more profitable for member banks to do so. This could have been done by setting the discount rate at a level below yields on Treasury securities. In fact, the discount rate was less than the yields on Treasury notes and bonds in late 1931, so presumably Friedman and Schwartz are suggesting its reduction to a point below the yield on Treasury bills. In my opinion this was not a feasible alternative. The traditional response to a gold outflow was to raise discount rates. This response was expected of the United States in late 1931. Had tradition been flagrantly violated and rates kept low in order to foster member bank borrowing, international confidence in American ability and desire to maintain the gold standard might have suffered a severe blow. There is little doubt that the gold drain would have accelerated, and, in all probability, the increased outflow would have more than offset Reserve Bank efforts to stimulate member bank borrowing.

Purchases of acceptances

Friedman and Schwartz assert that an increase in Federal Reserve holdings of acceptances was an alternative to the purchase of government securities and it was one which would have made no inroads on free gold since acceptances were acceptable as collateral for Reserve notes whereas

governments were not. System policy with regard to acceptances was to set its buying rate and purchase all bills offered at that rate. The Reserve Banks did not encourage sales of acceptances to them in late 1931, Friedman and Schwartz maintain, because their buying rate had risen to a point above the open market rate on acceptances. They argue that it was irrelevant to System holdings of acceptances that the buying rate was below the discount rate. It appears that this analysis is correct -- it was the relationship between the buying rate and the open market rate at this time rather than between the buying rate and the discount rate which determined A_F. The reasoning leading to this conclusion, and some of its implications are developed below. We employ a type of analysis similar to that used by Goldfeld and Kane (22) in their study of the determinants of member bank borrowing.

Assume that at time t a bank is faced with a certain need for reserves in order to meet deposit withdrawals and loan demand between t and t+1. We will term this reserve need ΔN. To obtain these reserves the bank may either borrow or sell acceptances. We define ΔA, as before, as the change in bank holdings of acceptances. Hence:

(5.3) $\quad \Delta N = B + \Delta A$

The cost of acquiring the necessary reserves is a function of the cost of borrowing and the cost of selling acceptances. If borrowing occurs, the cost is defined by $r_B B$ where r_B is the discount rate. The cost of selling acceptances, however, depends on to whom they are sold. If acceptances are sold to the Reserve Banks, the cost is:

(5.3) $\quad [-r_A + (r_F - r_A)] \Delta A = -r_F \Delta A$

where:

r_A = market rate on acceptances

r_F = buying rate on acceptances at Reserve Banks

If the buying rate were 2 1/2 percent, for example, but the market rate were 5 percent, an acceptance bought on the market at 95 could be sold to the System at 97.5 (approximately) on the same day. The loss from selling the acceptance to a Reserve Bank rather than holding it to maturity would therefore be only 2 1/2 percent.

If an acceptance is sold on the market, the loss from the sale is expressed by:

(5.4) $\quad -r_A \triangle A$

It becomes clear that if $\triangle N$ is given, and if the banker has decided to sell a certain amount of acceptances in obtaining $\triangle N$, he will choose whether to sell these acceptances to the Reserve Banks or on the market depending on the relationship between r_A and r_F. If $r_F < r_A$, the acceptances will be sold to the System; otherwise, they will be placed on the market. Friedman and Schwartz are therefore correct to stress the importance of this relationship in determining System holdings of acceptances.

In some circumstances, however, the relationship between r_F and r_B becomes important as well. If $r_F < r_A$, the relevant cost of obtaining a certain quantity of reserves, $\triangle N$, is given by:

(5.5) $\quad r_B B - r_F \triangle A$

and if $r_F > r_A$, the relevant cost becomes:

(5.6) $\quad r_B B - r_A \triangle A$

If minimizing the cost of obtaining these reserves is the banker's only concern, he will either borrow or sell acceptances depending on which is less costly, but he will not do both. The solution to the constrained cost minimization problem will be, in linear programming terminology, a corner solution. Consequently, even when $r_F < r_A$, if r_F is at the same time $> r_B$, the profit-maximizing bank would borrow rather than sell acceptances to the System.

Of course, there are factors other than relative cost which determine a bank's choice between these two methods of obtaining reserves, as well as the total amount of reserves needed. Some of these are accounted for in the model. For example, the greater the loan rate, the greater the reserve need since the banker will desire to lend more. Concern for liquidity and soundness will limit the extent to which the banker is willing to reduce his acceptance holdings and to increase borrowings. However, if the banker desires to minimize the cost of obtaining reserves, even if he does so subject to several constraints similar to those mentioned, the following relationships should hold:

(5.7) $\partial B/\partial r_B < 0$

(5.8) $\partial B/\partial r_A > 0$ if $r_F > r_A$

(5.9) $\partial B/\partial r_F > 0$ if $r_A > r_F$

(5.10) $\partial B/\partial \Delta N > 0$

(5.11) $\partial \Delta A/\partial r_B > 0$

(5.12) $\partial \Delta A/\partial r_F < 0$ if $r_F < r_A$

(5.13) $\partial \Delta A/\partial r_A < 0$ if $r_A < r_F$

(5.14) $\partial \Delta A/\partial \Delta N > 0$

Reducing the Federal Reserve buying rate to a point below the market rate should therefore have enhanced sales of acceptances to the Reserve Banks, and at the same time reduced borrowings.

This hypothesis was tested for the third quarter of 1931 by substituting for the actual market rate of 1.73 percent a hypothetical buying rate of .5 percent. The use of this alternative assumption reduced the predicted values of both A and B by exactly the same amount -- $115 million each. Member banks would have sold acceptances to the System, and used the proceeds to reduce borrowing to the extent of $115 million, according to the model. No change in D_L was predicted.

If the increase in System holdings of bills and discounts is precisely equal to the amount of acceptances sold plus the increase in borrowings by member banks ($\Delta A_F + \Delta B_F = \Delta B - \Delta A$), this test indicates that Reserve Bank holdings of eligible paper would have been unaltered by the reduction in the buying rate to .5 percent in late 1931. Free gold would therefore have suffered no deterioration. However, note that the predicted value of loans and of the money supply show no immediate increase, since the model predicts a simple substitution of acceptance sales for borrowings. Of course, due to the rise in free reserves, banks might subsequently have lent more freely. Moreover, any sales of acceptances to the Reserve Banks by those other than banks would have contributed to an expansion of reserves and deposits. It nevertheless appears that the reduction of the buying rate to .5 percent would have been an extremely ineffective way to stimulate the economy, and it would surely have been impossible to lower the rate much more.

Even if this hypothetical policy had been found to be very effective, its potential usage was limited. It was confined by the volume of acceptances held by the public. In December, 1931, there were only $418 million in acceptances held outside the Federal Reserve System. Given the traditional System policy of purchasing only "seasoned" bills, those which had been in the market for some time and were approaching maturity, the volume of bills which could have been added to Reserve Bank portfolios was considerably less than $418 million. Of course, a reduction in the System's buying rate might have fostered an increase in the supply of acceptances. However, it seems certain that the lack of available acceptances would still have prevented this policy from being a viable alternative to the purchase of government securities.

There was a potential disadvantage to a policy of maintaining low buying rates which, in my opinion, outweighed any possible advantages. This was the contingency that reduced buying rates might have spurred withdrawals of gold, particularly by the Bank of France. Villard (50, p. 733) disagrees, maintaining that:

> " ... the very orthodoxy of the Bank of France would have caused it to be particularly concerned with the discount rate and the open market policy to the exclusion of the acceptance situation. It is quite possible, therefore, that if the discount rate and open market policy had been kept at a level high enough to appear conservative to the Bank of France, maintenance of the acceptance portfolio might not have upset the French."

This argument is not particularly convincing. From late October, 1931, until the passage of the Glass-Steagall Act, the Reserve Bank buying rate was above the market rate. During this interval, Reserve Bank holdings of acceptances for foreign correspondents rose rapidly, from

$99 million to $312 million. It seems likely that the willingness of foreigners to hold these American acceptances rather than withdrawing their balances in gold was a function of their increased profitability as well as of the confidence engendered by Reserve Bank willingness to raise rates. The probability that lower buying rates would have produced the conversion of some foreign-held acceptances into gold seems very great indeed.

My conclusion is that a reduction in Reserve Bank acceptance rates would have been an ineffective and dangerous alternative to the purchase of government securities in late 1931.

Other Aspects of the Friedman-Schwartz Argument

Points 1, 2, 3 and 5[1] of the Friedman-Schwartz discussion, are more qualitative in nature than the others we have discussed, and are primarily devoted to subjective estimation of the degree of Federal Reserve anxiety over free gold. In this section we present some observations on these more qualitative aspects of the Friedman-Schwartz analysis.

To demonstrate the lack of widespread concern over, or even knowledge of, free gold, Friedman and Schwartz (18, p. 401) tell us that "the earliest published full-dress discussion of free gold during the 1929-33 contraction" appeared in September, 1930. This statement is so carefully phrased that it is rather misleading.

In a March, 1930, article, Benjamin Anderson (3) warned that free gold "though adequate, is not superabundant, when all circumstances are

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[1] See pp. 8-9.

taken into account." (3, p. 13) Anderson maintained that cheap money policy would produce deterioration of the free gold position. This was the first article written during the 1929-1933 contraction that I have found, but perhaps Friedman and Schwartz could legitimately contend that it was not a "full-dress discussion" (18, p. 401) of the free gold problem.

There were, however, published discussions of free gold which appeared immediately prior to the beginning of the downturn -- one written by Burgess (11) in February, 1929, and one in the Federal Reserve Bulletin for September, 1928 (49, 1928, pp. 613-14). Burgess makes it clear that free gold was a continuous factor in the determination of Reserve policy. He forecasts that free gold might decline somewhat in future months, as gold withdrawals and increases in currency in circulation were likely. However, he states, "the present gold position does not offer cause for alarm." We have been finding ways to economize on gold and "if necessary, more means of gold economy can be found, even if substantial modifications in our banking law should be required." (11, p. 24) Similar sentiments are expressed in the Federal Reserve Bulletin (49, 1928) where it is explained that free gold currently exceeds its usual level due to abnormally large holdings of eligible paper in Reserve Banks, and would be much less under normal circumstances. Writing in January, 1931, Beckhart warned that free gold holdings were small "and under conditions that might develop could drop to a point that would require a reversal of the present 'cheap money policy.'" (8, p. 102) The concept of free gold was becoming more and more well-publicized during the period following the crash, and although its level was not a cause for alarm prior to the autumn of 1931, it was being closely watched.

According to Friedman and Schwartz, System documents reveal that the level of free gold was "not ... a source of concern to the Board" (18, p. 401), even during the fall of 1931. This argument is given force by the statement of the Board in its November, 1931, Bulletin (49, 1931, pp. 603-04). During September and October, the U. S. had lost $730 million in gold, and currency outstanding had risen by $390 million. It would seem that if free gold were ever a concern, it would have been so at this point. However, the Board painted an extremely rosy picture of the situation. The System's reserve ratio (the ratio of total reserves to deposit and note liabilities) could be increased if gold certificates in circulation were replaced by Reserve notes, the Board reassured its readers. It is true that this policy would have increased the reserve ratio, but it would not have increased free gold, as the Board itself had pointed out in 1928 (49, 1928, pp. 613-14). Moreover, the Board declared that the level of free gold did not limit the ability of the Reserve Banks to meet further demands for gold and for currency, because when such demands arose, more eligible paper would be pledged. This statement implies a tight money policy of forcing banks to obtain reserves by discounting, rather than the provision of reserves through open market operations. Finally, the official statement maintained that free gold could be increased by reducing the vault cash of Federal Reserve Banks. This policy had already been utilized to the extent of $100 thousand during the six weeks ending on October 28.

It seems reasonably certain that this statement cannot be taken at face value leading to the conclusion that Reserve officials were not con-

cerned over free gold. Whatever Reserve officials' real degree of anxiety over the free gold position, their statement was obviously written for the purpose of reassuring the American public and foreign investors that the gold reserves of the U. S. were adequate to meet the crisis. It was clearly impossible to have done otherwise. Had the Board written that the level of free gold was rapidly declining, and that it could not pursue a vigorous easy money policy without causing a further deterioration or even elimination of free gold, the repercussions would probably have been dramatic -- panic-stricken gold withdrawals and a surge in currency hoarding.[1]

The evidence suggests that concern over free gold was an important restraining factor on Reserve System policy between September, 1931, and February, 1932. Such concern was surely not the factor preventing monetary authorities from pursuing large-scale open market operations prior to that time, however. In March, 1932, the Board itself stated that, "until recent months, collateral requirements were not an important element in the situation." (49, 1932, p. 144)

One might wonder why, if the System regarded free gold as a serious handicap to a desired policy, it did not push for the changes embodied in the Glass-Steagall Act until early February, 1932, at which time Harrison wrote to Senator Glass suggesting such legislation. In fact, according

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[1]Harris seems to agree in this: "In 1928-29, the authorities put the emphasis on free gold, because in that manner they could minimize the amount of reserves available for further expansion; but in 1930-31 they were to regret the publicity given to this view, for they now had to minimize the importance of losses of free gold." (27, p. 379)

to Friedman and Schwartz, the real push for the legislation came from the White House and the Treasury. During House hearings on the Goldsborough bill in April, 1932, Governor Harrison stated that the rather passive policy pursued after early 1930 was due partly to "the fact that we did not have at that time the Glass-Steagall bill," to which Goldsborough responded, "You could have gotten it." (47, p. 488) However, two pages later, Goldsborough asserted that the bill could not have passed the Senate without the one-year limitation attached to it (47, p. 490). This latter statement suggests that until emergency conditions became imminently clear to that legislative body, they might have refused to pass the bill at all. Hence, one reason for the System's reticence in requesting legislation may have been a feeling that it was a hopeless cause. Goldenweiser (20, p. 160) concurs in this view:

> "The System could be criticized for not advocating vigorously the necessary changes in the law, but the prospect of obtaining such legislation was not promising as long as Congress was dominated by traditional conceptions about the issue of currency."

He adds, however, that it was not only pessimism as to the success of a request for legislation which produced the System's passivity: "Nor was the System's grasp of the issues involved so clear and widespread as it became in later years." (20, p. 160)

If the System were truly concerned over lack of ability to use government securities as collateral in late 1931, one would expect that when such a policy were authorized, government securities would have been immediately pledged. Such was not the case. No government securities were pledged until May 5, 1932. According to Villard (50, p. 736):

> " ... it seems clear from the failure immediately to utilize the powers of the Glass-Steagall Act that the authorities, previous to the passage of the Act, were not solely restrained by fear of inadequate free gold resulting from expansionary actions on their part."

The temporary nature of the Glass-Steagall legislation may have inhibited the System from using its new authority to the full. Speaking during the hearings on the Goldsborough bill, Harriton (47, p. 493) stated:

> "I do not think there is any necessity for further legislation at the present time, if we could assume that the provisions of the Glass-Steagall bill are permanent, rather than limited to one year. That is unavoidably a restraining influence, certainly, on some of the managers of the System."

Perhaps because the legislation was temporary, the System settled on a very restrictive rule-of-thumb for the pledging of government securities as collateral.

> "In determining upon a formula ... the Board decided that in existing circumstances when the margin between (1) total cash reserves of the Reserve Banks (in excess of the 35 percent against deposits) plus eligible paper at the 12 Federal Reserve Banks, and (2) Federal Reserve notes in actual circulation shall fall below $400,000,000, the Reserve Banks shall be authorized to pledge a sufficient amount of United States Government securities with the Federal Reserve Agents to release enough gold to bring this margin up to the $400,000,000 level." (49, 1932, p. 286)

This was indeed a cautious policy, for the margin of $400 million had to be used to provide collateral against Reserve notes not in circulation and to satisfy the requirements of the redemption fund. These additional requirements could, and did, reduce free gold to very low levels -- substantially below $400 million.

My conclusion is that the free gold position exerted an important restraining influence on Federal Reserve authorities after Britain

suspended gold payments, but I agree with Friedman and Schwartz that it was not the only factor which prevented the System from embarking on a large open market campaign. Clay Anderson (6), whose book is based primarily on the views of System officials as recorded in the minutes and the proceedings of groups such as the Open Market Policy Conference and the Conference of Reserve Bank Presidents, mentions several additional reasons for the growing opposition to security purchases. Some officials who had previously favored additional purchases thought that member banks, due to anxiety over their liquidity, would now hold the funds so created as excess reserves thus making the program ineffective. Furthermore,

> "several presidents were becoming seriously concerned over the reserve position of their Reserve Banks .... Sudden demands by member banks might prove embarrassing if the System's resources were tied up in Government securities." (6, p. 67

This was a concern closely related to that over free gold, but it was primarily apprehension over the liquidity of the Reserve Banks themselves. Certain Reserve Bank presidents seemed to view their institutions as ordinary banks with the liquidity problems of such banks, rather than as central banks. Indeed, some Reserve Bank presidents were so concerned that they refused to participate in further purchases. Finally, there were still some System officials who adhered to the view that the depression had resulted mainly from non-monetary causes such as overproduction and excess capacity, which could not be remedied by a cheap money policy. They had opposed open market purchases all along, and continued to do so in late 1931.

Anderson does assign prominent place to free gold among the reasons for the passive policy of late 1931, as did Governor Harrison of the New

York Reserve Bank, who had vigorously advocated larger open market purchases between 1929 and the autumn of 1931. In April, 1932, Harrison told the House Committee on Banking and Currency:

> " ... I think we were wise, through the months of September, October, and November and even December [1931], in not pursuing a vigorous policy of Government purchases .. for three reasons: First, because of the fact that we were having a raid on our gold from abroad; second, currency was going up at a terrific rate -- both of those things would have offset anything we could have done by purchasing governments; and the third reason was, and it is a practical reason, that because of the technical limitations in the law we did not have enough free gold to justify our doing it."[1] (47, p. 478)

One final question remains: Was the large-scale purchase program begun only because of pressure from Congressional critics as Friedman and Schwartz (18) assert, and if not, why was it undertaken? Whitney (51) provides the most unique answer to this question we have found. She suggests that:

> " ... the fact that the Treasury had been forced to increase its indebtedness ever since the close of the fiscal year 1930 may have been one factor inducing the Reserve Banks to purchase one billion dollars' worth of government securities in the spring of 1932. But the fiction that this measure was started to aid the money market was maintained by having the Reserve banks buy from the market instead of from the Treasury directly ...." (51, p. 63)

Whitney's theory of conspiracy between the Reserve Banks and the Treasury is interesting, but highly improbable. The majority of those who have discussed the reasons for the policy change of 1932 accept unquestioningly the Board's contention that, having been freed from restraining legal requirements, the System readily embarked on the policy it had considered desirable for months. It is doubtful that any single-cause explanation for the program is adequate -- either that given by the Board or that expounded by Friedman and Schwartz.

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[1] My underlining.

Friedman and Schwartz assert that the open market campaign did not begin until six weeks after passage of the Glass-Steagall Act. This is true only if one disregards purchases of $25 million per week which began on the first of March. Purchases of this size were, in fact, very large by the standards of the day, and beginning as they did only a few days after passage of the Act, it is hard to deny that the legislation did lead to a change of policy. It is not clear whether pressure from Congress also influenced monetary policy decisions in March and early April, but in mid-April a rather strange coincidence developed. Hearings on the Goldsborough bill, which provided that the monetary authorities be directed to raise the price level to some specific point (the 1926 level was frequently mentioned) were underway on April 13 and 14. Not surprisingly, Reserve officials were unalterably opposed to any such proposal, and they must have been rather apprehensive as to its outcome, for the bill had quite a number of adherents, particularly in the House. Governor Harrison was to testify at committee hearings on the bill on April 13. On April 12, the Open Market Policy Conference decided to step up its rate of purchase to $100 million per week. During his testimony, Harrison made numerous references to the dramatic policy change upon which Reserve officials had agreed, although he did not specify what the new rate of purchase was to be. This sequence of events gives support to the Friedman-Schwartz (18) contention that Congressional pressure influenced the System's decisions. The acceleration in the rate of purchase was very likely an attempt to head-off the prospects for passage of the Goldsborough bill. Congressional pressure was not, however, the primary factor responsible for the initiation of the program in March.

Friedman and Schwartz (18) imply that security purchases ended in July, 1932, because Congress had adjourned, and freed from pressure by that body, Reserve officials no longer felt obligated to pursue a policy in which they had little faith. Our evidence leads to a different conclusion. Anderson (6, p. 70) states that during the open market campaign, "the immediate target of open market operations shifted from a certain quantity of purchases to building up and maintaining excess reserves." In June, 1932, System officials agreed to use open market policy to maintain excess reserves at a level of $250 to $300 million. During the second half of 1931, imports of gold and a return flow of currency produced a substantial expansion of excess reserves. The target was therefore achieved with no further increase in Reserve Bank security holdings. The program was ended because the target was met, not, in my opinion, because of a lapse in Congressional criticism of monetary policy.

CHAPTER VI. SUMMARY AND CONCLUSIONS

Professors Friedman and Schwartz place major responsibility for the intensity and duration of the Great Depression with policymakers in Washington, D. C. -- but not with the creators of fiscal policy, who have so frequently received the blame. Friedman and Schwartz believe that officials of the Federal Reserve System showed even greater ineptitude during those years of crisis, and their argument has greatly influenced a number of contemporary historians. "How different," the foremost modern-quantity theorist laments,

> "the history of that fateful dozen years might have been if the money stock had grown steadily at its average rate of 2 1/2 per cent per year ... instead of first falling by one-third from 1929 to 1933 and then doubling from 1933 to 1941." (18, p. 545)

This paper has dealt with monetary policy during one small segment of this protracted economic slump -- the period beginning with the British departure from gold on September 21, 1931, and ending with the passage of the Glass-Steagall Act on February 27, 1932. It has been our purpose to ascertain whether System authorities were so constrained during this interval by legal requirements pertaining to collateral for Federal Reserve notes that they could not have pursued a more active policy. Such was the official System argument. Friedman and Schwartz contend that the supposed free gold problem resulting from these anachronistic legal requirements was a rationalization rather than a legitimate reason for the insufficiency and inappropriateness of the policy pursued. They suggest that open market purchases of $1 billion could and should have been undertaken, and that an operation of that size would have been sufficient to

maintain stability of the money stock -- a most crucial requirement for deterring economic instability in their opinion.

Evidence presented in this study suggests that, if Reserve System officials were unalterably committed to the objective of maintaining free gold at some positive level, the attainment of this objective was inconsistent with the adoption of large-scale open market purchases in late 1931. A shortage of free gold was a highly-probable consequence of a vigorous open market policy. This conclusion was derived by using a rather basic model of bank portfolio behavior to predict bank borrowings and acceptance holdings, in conjunction with specific assumptions concerning the effect of a hypothetical security purchase on other determinants of free gold. Interestingly, the same conclusion results from the employment of these assumptions with the Friedman-Schwartz predictions for borrowings and acceptance holdings.

The results obtained in Chapter V also suggest that a $1 billion security purchase would have been insufficient to prevent continued deterioration of the money stock, although it would, of course, have lessened the rate of decline. Had monetary authorities set as their first priority the provision of a stable or growing money supply, it seems clear that free gold would have become nonexistent or negative.

Other alternatives which Friedman and Schwartz considered viable solutions to a free gold shortage were found to be vastly overrated. The reduction of till money at Reserve Banks to the minimum level necessary for continued operation would have increased free gold, but not sufficiently to support such a sizeable open market purchase. It was argued

that the encouragement of member bank borrowings by the use of direct pressure would have been of little avail, in light of existing economic conditions; and that it was impossible to provide such encouragement through reductions in the discount rate so long as the U. S. was firmly committed to maintaining the gold standard. The potential effect of the third alternative, purchases of acceptances rather than government securities, was investigated through the use of the bank-behavior model, and was found to have no immediate effect on free gold or System holdings of eligible paper -- or on the money supply. It was therefore concluded that this was a very weak policy instrument. Moreover, due to the limited availability of acceptances outside Federal Reserve Banks, it could not have been pursued to any great extent.

It seems, then, that a lack of free gold did impose a serious constraint on the System's ability to actively engage in open market operations during the autumn and winter of 1931. Since this was the only truly available instrument for pursuing an easy money policy, the conclusion follows that there was little that monetary authorities could have done to prevent the precipitate drop in the money stock which occurred during those months. System policy was justifiable at least for this small portion of the depression period.

These conclusions are drawn without regard to what considerations actually determined the policy decisions of late 1931. A free gold shortage would have likely resulted from Reserve Bank purchases of $1 billion; but this is not to say that anxiety over this contingency was the factor determining Federal Reserve policy. From the writings of

System officials, it seems clear that the deteriorating level of free gold had an important effect on the decisions made; but there were additional reasons for the opposition to open market purchases which had nothing to do with free gold. Some Reserve Bank presidents viewed this tool as an ineffective weapon for dealing with depression in general, and would have voted against open market operations regardless of the free gold position. Concern for the liquidity of their individual banks was uppermost in the minds of other Reserve Bank officials. Finally, a sense of helplessness as the depression deepened may have fostered a paralysis of policy.

Whatever the real reasons for the decisions made during the closing months of 1931 -- whether the System actually regarded free gold as a barrier to a dynamic policy or this argument was only rationalization for an inactive policy which would have been pursued in any case -- the policy was not inappropriate. Given the legal collateral requirements which resulted in unusually low levels for free gold during those months, and a System objective of preventing the complete elimination of that quantity, it was impossible for monetary authorities to have done much more to ease the country's economic miseries.

BIBLIOGRAPHY

1. Anderson, Benjamin M. Economics and the public welfare; financial and economic history of the United States, 1914-1946. New York, New York, D. Van Nostrand Co., Inc. 1949.

2. Anderson, Benjamin M. The "free gold" of the Federal Reserve System and the cheap money policy. Chase Economic Bulletin 10, No. 3: 3-25. September 1930.

3. Anderson, Benjamin M. Gold and goods. Chase Economic Bulletin 10, No. 1: 12-21. March 1930.

4. Anderson, Benjamin M. The gold standard and American gold tradition. Chase Economic Bulletin 11, No. 5: 3-18. November 1931.

5. Anderson, Benjamin M. Our gold standard has not been in danger for thirty-six years. Chase Economic Bulletin 12, No. 3: 3-16. November 1932.

6. Anderson, Clay J. A half-century of Federal Reserve policymaking, 1914-1964. Federal Reserve Bank of Philadelphia. 1965.

7. Bagehot, Walter. Lombard street: a description of the money market. New York, New York, Charles Scribners' Sons. 1892.

8. Beckhart, B. H. The "free gold" of the Federal Reserve Banks and its relation to credit policy. Annalist 37: 102, 147-50. 1931.

9. Board of Governors of the Federal Reserve System. Banking and monetary statistics. Washington, D. C., The National Capital Press. 1943.

10. Bopp, Karl. Two notes on the Federal Reserve System. Journal of Political Economy 40: 379-90. 1932.

11. Burgess, W. Randolph. The money market in 1928. Review of Economic Statistics 11: 19-25. 1929.

12. Burgess, W. Randolph. The Reserve Banks and the money market. 2nd ed. New York, New York, Harper and Brothers. 1946.

13. Crosse, Howard D. Management policies for commercial banks. Englewood Cliffs, New Jersey, Prentice-Hall, Inc. 1962.

14. Currie, Lauchlin. The failure of monetary policy to prevent the depression of 1929-32. Journal of Political Economy 42: 145-77. 1934.

15. Durbin, E. F. M. The problem of credit policy. New York, New York, John Wiley and Sons, Inc. 1935.

16. Edie, Lionel D. The banks and prosperity. New York, New York, Harper and Brothers. 1931.

17. Friedman, Milton. A theory of the consumption function. Princeton, New Jersey, Princeton University Press. 1957.

18. Friedman, Milton and Schwartz, Anna Jacobson. A monetary history of the United States, 1867-1960. Princeton, New Jersey, Princeton University Press. 1963.

19. Gayer, Arthur D. Monetary policy and economic stabilization. New York, New York, The Macmillan Co. 1935.

20. Goldenweiser, E. A. American monetary policy. New York, New York, McGraw-Hill Book Co., Inc. 1951.

21. Goldenweiser, E. A. Instruments of Federal Reserve policy. In Members of the Staff of the Board of Governors of the Federal Reserve System. Banking Studies. Pp. 391-414. Baltimore, Maryland, Waverly Press, Inc. 1941.

22. Goldfeld, Stephen M. and Kane, Edward J. The determinants of member bank borrowing: an econometric study. Journal of Finance 21: 499-514. 1966.

23. Gregory, T. E. The gold standard and its future. New York, New York, E. P. Dutton and Co. 1932.

24. Hardy, Charles O. Credit policies of the Federal Reserve System. Washington, D. C., The Brookings Institution. 1932.

25. Harris, S. E. Banking and currency legislation, 1932. Quarterly Journal of Economics 46: 546-57. 1932.

26. Harris, S. E. The Federal Reserve Act and Federal Reserve policies. Quarterly Journal of Economics 45: 371-408. 1931.

27. Harris, S. E. Twenty years of Federal Reserve policy. 2 vols. Cambridge, Massachusetts, Harvard University Press. 1933.

28. Hawtrey, R. G. The art of central banking. New York, New York, Longmans, Green and Co. 1933.

29. Hawtrey, R. G. A century of bank rate. New York, New York, Longmans, Green and Co. 1938.

30. Horvitz, Paul M. Monetary policy and the financial system. 2nd ed. Englewood Cliffs, New Jersey, Prentice-Hall, Inc. 1969.

31. Murchison, C. T. Do Reserve Bank notes need specific collateral? American Bankers Association Journal 1930: 1162, 1188-90. June 1930.

32. Paris, James D. Monetary policies of the United States, 1932-38. New York, New York, Columbia University Press. 1938.

33. Patnaik, P. B. The non-central chi-square and F - distributions and their applications. Biometrika 36: 202-32. 1949.

34. Reed, H. L. Reserve Bank policy and economic planning. American Economic Review 23: 108-18. 1933.

35. Reed, Harold L. Federal Reserve policy, 1921-30. New York, New York, McGraw-Hill Book Co. 1931.

36. Riefler, Winfield W. The dilemma of central banking as illustrated in recent literature. Quarterly Journal of Economics 50: 706-18. 1936.

37. Riefler, Winfield W. Money rates and money markets in the United States. New York, New York, Harper and Brothers. 1930.

38. Robertson, Ross M. History of the American economy. 2nd ed. New York, New York, Harcourt, Brace and World, Inc. 1964.

39. Robinson, Roland I. The management of bank funds. New York, New York, McGraw-Hill Book Co., Inc. 1962.

40. Rogers, James Harvey. America weighs her gold. New Haven, Connecticut, Yale University Press. 1931.

41. Sengupta, J. K. A generalization of some distribution aspects of chance-constrained linear programming. To be published in International Economic Review circa 1970.

42. Studenski, Paul and Kroos, Herman E. Financial history of the United States. 2nd ed. New York, New York, McGraw-Hill Book Co., Inc. 1963.

43. Thomas, Woodlief. Monetary controls. In Members of the Staff of the Board of Governors of the Federal Reserve System. Banking studies. Pp. 323-50. Baltimore, Maryland, Waverly Press, Inc. 1941.

44. Timberlake, Richard H., Jr. Money, banking and central banking. New York, New York, Harper and Row. 1965.

45. Trescott, Paul B. Money, banking and economic welfare. 2nd ed. New York, New York, McGraw-Hill Book Co. 1965.

46. Turner, Robert C. Member-bank borrowing. Columbus, Ohio, Ohio State University. 1938.

47. U. S. Congress. House. Committee on Banking and Currency. Stabilization of Commodity Prices. Hearings before the subcommittee of the committee on banking and currency, 72nd Congress, 1st session, on H. R. 10517. Washington, D. C., U. S. Government Printing Office. 1932.

48. U. S. Federal Reserve Board. Annual Reports 15-23. Washington, D. C., U. S. Government Printing Office. 1928-1936.

49. U. S. Federal Reserve Board. Federal Reserve Bulletins 14-22. 1928-1936.

50. Villard, H. H. The Federal Reserve System's monetary policy in 1931 and 1932. Journal of Political Economy 45: 721-39. 1937.

51. Whitney, Caroline. Experiments in credit control: the Federal Reserve System. New York, New York, Columbia University Press. 1934.

52. Willis, H. Parker. The theory and practice of central banking. New York, New York, Harper and Row. 1936.

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APPENDIX

The following is a list of the symbols most frequently used in this study and their definitions:

1. G_F = free gold
2. R_F = total reserves of Federal Reserve Banks = gold + lawful money
3. G_C = gold required as collateral against Federal Reserve notes
4. D_T = total deposit liabilities of Federal Reserve Banks = $D_M + D_G + D_N$
5. E_P = eligible paper pledged as collateral against Federal Reserve notes
6. N_I = Federal Reserve notes issued to Reserve Banks
7. D_M = member bank reserves (deposits) with Federal Reserve Banks
8. B_F = bills discounted and advances made by Reserve Banks
9. A_F = bills bought by Reserve Banks
10. G_S = U. S. Government securities held by Reserve Banks
11. MG = monetary gold stock
12. O = other Reserve Bank credit + Treasury currency - Treasury cash - other Federal Reserve accounts
13. C = currency in circulation = $C_F + C_O$
14. D_G = Treasury deposits with Federal Reserve Banks
15. D_N = non-member bank deposits with Federal Reserve Banks
16. C_F = Federal Reserve notes in circulation
17. C_O = other currency in circulation
18. C_R = Federal Reserve notes held by Reserve Banks and by the U. S. Treasury

19. M = money stock = C + D

20. D = total bank deposits = DD_N + TD

21. E [ ] = expected value of bracketed term

22. π = profits

23. A = bank holdings of acceptances

24. U_B = bank holdings of Treasury bills

25. S = bank loans to brokers and dealers

26. U_G = bank holdings of Treasury bonds

27. U_N = bank holdings of Treasury notes

28. M = bank holdings of state and local government bonds

29. R = bank holdings of railroad bonds

30. U = bank holdings of utility bonds

31. P = bank holdings of commercial paper

32. L = D_L = bank loans to customers = deposits created in the process of granting loans

33. B = borrowings at Reserve Banks

34. r_A, r_{U_B}, r_S, r_{U_G}, r_{U_N}, r_M, r_R, r_U, r_P, r_L or r_{D_L}, r_B = rate of return on A, U_B, S, U_G, U_N, M, R, U, P, L or D_L, B

35. E = excess reserves

36. V = vault cash

37. TD = time deposits

38. DD_N = net demand deposits

39. RR = required reserves against demand and time deposits

40. v = 1 - required reserve ratio for demand deposits

41. s = 1 - required reserve ratio on time deposits

42. $D_P = DD_N - D_L$ = demand deposits other than those created in the process of granting loans

43. α = minimum acceptable short-term asset-deposit ratio

44. K = capital accounts

45. O_1 = other bank assets

46. β = desired risk-asset ratio

47. G_X = U. S. Government securities available to the private sector

48. r_F = buying rate on acceptances at Federal Reserve Banks

49. ΔN = quantity of reserves needed between t and t+1

50. t = present time